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DO-IT-YOURSELF TV SERVICING

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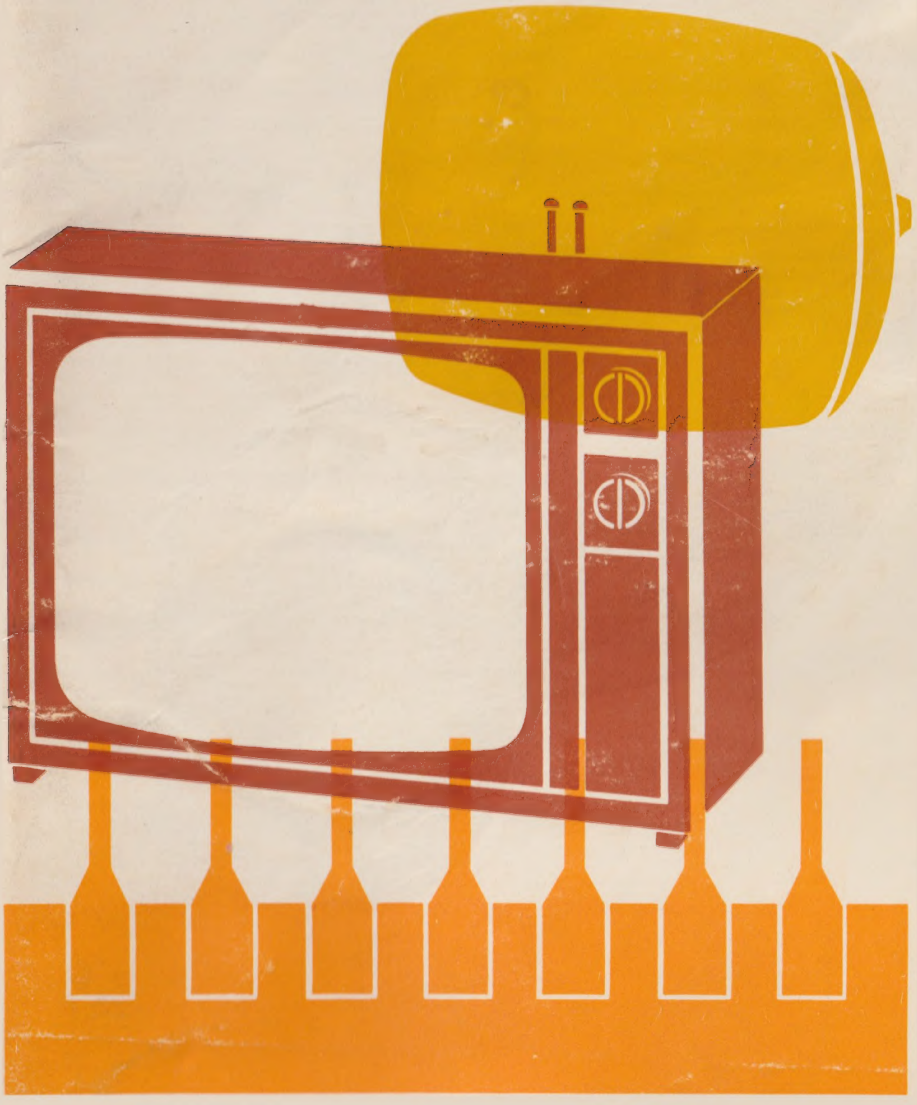

DO-IT-YOURSELF TV SERVICING

by Philip D. Kennedy

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Preface

Since the end of World War II, modern technology has brought a great many changes into the lives of most Americans. And of all these changes, probably none has had a greater effect than television. At least one television receiver can be found in almost every American home and a great number of families have two or more sets. In fact, television has become so commonplace that it is pretty much taken for granted. Most set owners never give a thought as to how this electronic marvel can become their window to the world. They are content to sit back in their easy chairs and enjoy a recent movie in full color, watch a football game live from a vantage point superior to the best seat in the stadium, or see history unfolding before them.

This contentment ends abruptly, however, when the television set ceases to function properly. It is replaced by all sorts of hostile emotions ranging from dismay to pure outrage. When the television breaks down, the reaction of most people is to *guess* what's wrong with the thing. Since most set owners have little or no knowledge of how a television receiver works, there is little chance that their conclusion will be any more than a guess. The only positive approach left to most people is to pick up the phone and call the television repairman.

The purpose of this book is to give the reader a basic understanding of how a television receiver works. The first chapter begins with an explanation of how the picture tube produces a picture. The various sections of the receiver are discussed in simplified terms and block diagrams are used to show how these individual sections are related in the overall operation of the receiver. In keeping with the basic nature of this book, there will be no discussion of circuitry. Chapter 2 explains the operation and effects of the receiver controls, including those normally reserved for the serviceman. Where practical, photos are used to show the effects of these controls. The chapter should enable the reader to confidently make minor adjustments to his set. There are

controls which should only be adjusted by a qualified serviceman and they will be identified accordingly.

Chapter 3 describes several repairs which most set owners can perform. While this book is not intended to be a "do-it-yourself" repair manual, it will provide the knowledge to perform repairs and maintenance procedures within the capabilities of most people. Chapter 4 discusses the practicality of checking tubes on a drugstore type tube tester. While this is not a recommended procedure for everyone, there are quite a few people who make it a practice to test their own tubes when the tv set breaks down. This chapter not only presents the pros and cons of testing your own tubes, it provides a good deal of helpful information to those who decide to take this route. From this information, the reader should be able to relate a particular symptom directly to the tubes that may be causing the problem. This eliminates the risk of removing all of the tubes from the set and then putting some of them back into the wrong sockets.

While it is the objective of this book to enable the set owner to perform some minor repairs, there will come a time, sooner or later, when it will become necessary to call the television serviceman. Chapter 5 gives some helpful suggestions in selecting a television serviceman if you do not already have one. This chapter tells why it is sometimes necessary for your set to be taken to the shop. The normal responsibilities of both the serviceman and the set owner are outlined in this chapter. Warranties and guarantees, which are often misunderstood, are also discussed here. The cost of television repairs is a major concern to almost every set owner. Sometimes the rates quoted by a service shop are confusing and occasionally misleading. In order to help avoid misunderstandings, this chapter explains the various methods of charging for television service.

If you would like to know more about the operation of your television receiver, I think you will find this book interesting and informative. Even if you have some knowledge of television and occasionally repair your own set, you will find this book a useful reference source.

Philip D. Kennedy

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SECTION 1

How Your TV Works

The distinctive characteristic of a television receiver that makes it different from a radio is its ability to produce a picture. Everyone has heard the saying: "A picture is worth a thousand words." And so it is with television that we can absorb so much more information than we can by just listening to the sound from a radio. The technology of television has advanced to the point that we are not only able to watch events happening around the world, most of us have actually witnessed the first explorations of the moon on live television. Things that we could only read about a few years ago can now be seen in full color from the comfort of our own homes.

While television may seem to be an unexplainable miracle to many people, it is actually vivid testimony to man's technological accomplishments over the past few years. There is nothing magical or mysterious about a television receiver being able to produce a picture. Therefore, we will begin this chapter with a simplified explanation of how the picture tube is able to display a picture of remarkable quality.

PRODUCING THE PICTURE

There are many components in a television receiver and they all have a specific role in producing the picture and the

accompanying sound. As far as the picture is concerned, the picture tube is the most important and unique component. It is the picture tube that transforms electrical energy into the light that becomes an image to our eyes. A typical picture tube is shown in Fig. 1. The narrow cylindrical portion at the rear of the tube is the *neck*. It encloses an *electron gun* which projects a narrow, high-velocity beam of electrons toward the face of the picture tube. The inside surface of the face is coated with a phosphor that emits a small spot of light when struck by the narrow electron beam. The outer surface of the picture-tube face is the television screen. Since the screen is essentially clear glass, the light emitted

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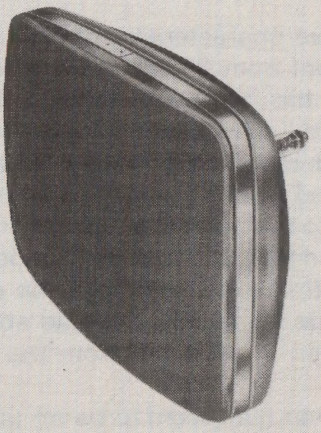
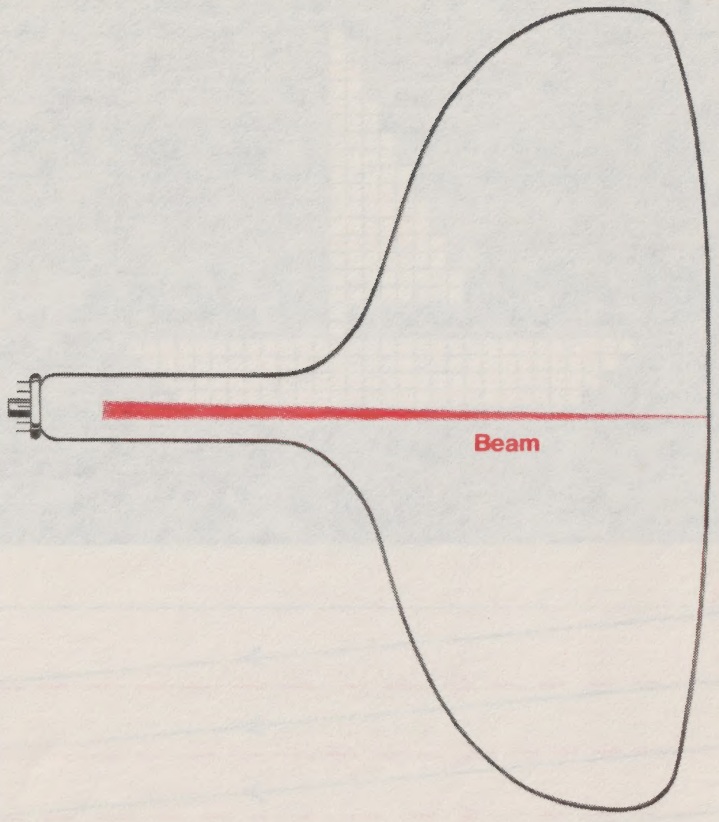


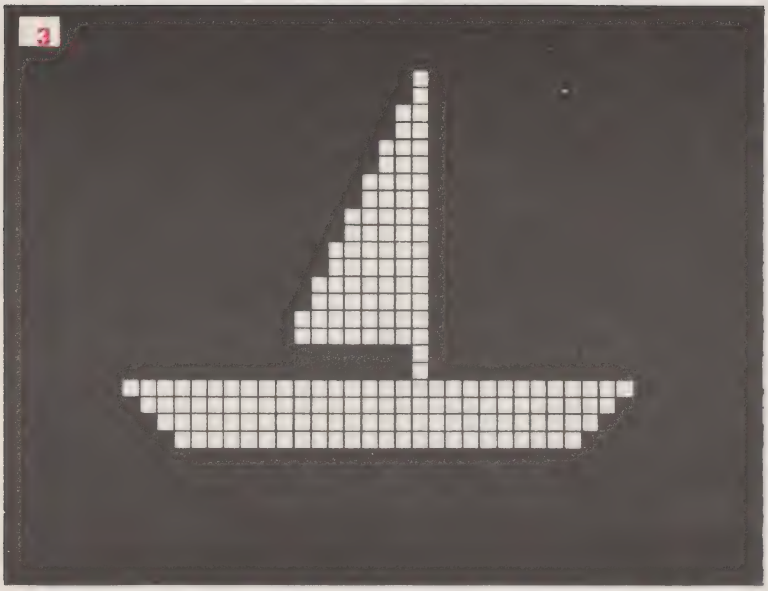
by the phosphor surface is viewable on the screen. Fig. 2 shows a cutaway view of a black-and-white picture tube.

You may ask how a single electron beam can illuminate the entire television screen and produce a picture of varying brilliance. For the moment, refer to the simple picture of a sailboat shown in Fig. 3. As you can see, the picture is actually made up of small white squares. Let us suppose that each square represents the small illuminated spot produced by the electron beam. Now, if we had a separate electron beam for each small area of the screen, and we could turn each beam on and off at will, it would be possible to produce



any simple picture. And if we could vary the intensity of the light emitted by the electron beam, it would be possible to produce a complex picture with varying degrees of shading.

Since we have only one electron beam in the picture tube, we can illuminate only one very small area of the screen at a given time. However, by moving the single beam across the face of the picture tube several times in rapid succession, it is possible to illuminate the entire screen. Fig. 4 shows the path traced by the beam as it moves across the screen. Notice that the solid lines, which represent beam movement from left to right when viewed from the front of the tube, slope slightly downward. This is due to the fact that while the beam is moving across the screen, it is also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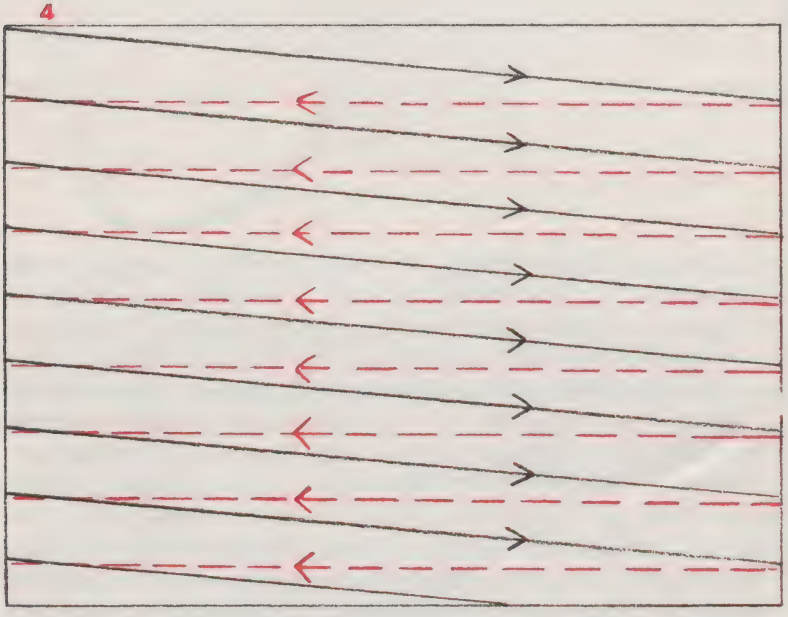
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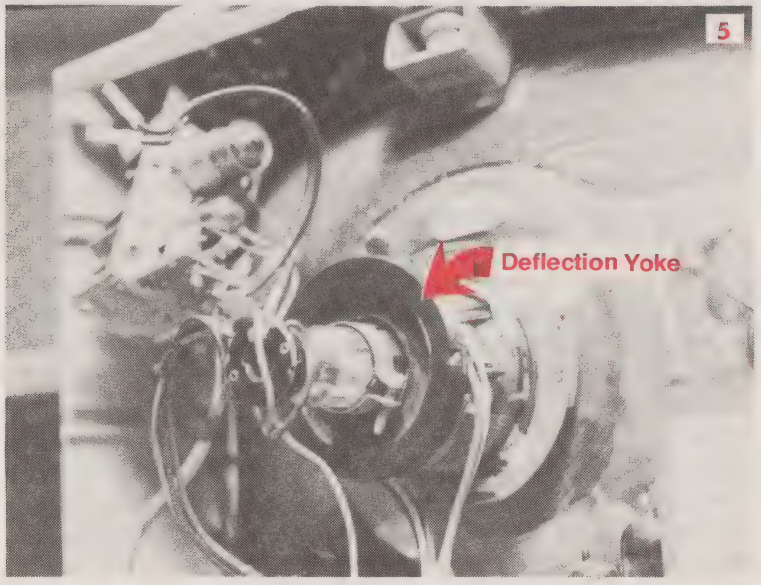
moving downward at a much slower rate. This allows the complete television screen to be uniformly *scanned.* The movement of the electron beam is caused by a rapidly changing magnetic field within the neck of the picture tube. This magnetic field is produced by a set of coils called a deflection yoke which is mounted on the neck of the picture tube. Fig. 5 shows a deflection yoke installed on a black-and-white tube.



The electron gun employed in a television picture tube is actually a vacuum tube which is controlled by the voltages applied to it. Therefore, the brilliance of the small illuminated spot on the screen can be determined by varying the voltage applied to the picture tube. This varying voltage is known as the *video* signal.

Referring back to the sailboat shown in Fig. 3, let us imagine that each row of squares represents a single horizontal scan of the electron beam. The entire "screen" shown in Fig. 3 has only 34 horizontal lines. Also, each horizontal line contains only 45 squares. Multiplying 45 times 34 (the number of lines), we can see the entire picture contains only 1530

squares. In television, these squares which represent the area illuminated by a single electron beam, are called picture *elements.* An actual television picture is made up of about 480 viewable horizontal scanning lines and contains nearly 300,000 elements. It is obvious, therefore, that a television picture has much better definition than our sailboat. Note in Fig. 4 that only a few horizontal scanning lines are shown. It would have been impossible to illustrate our point if all 480 lines had been shown. It should also be obvious that in an actual television picture the downward slope of each horizontal line is too small to be noticeable.

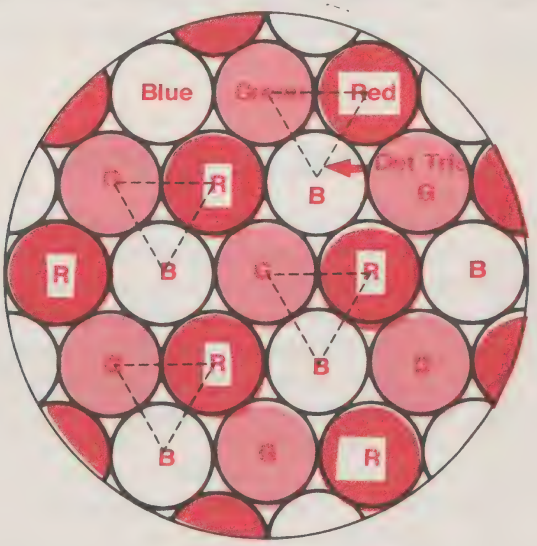
The dashed lines in Fig. 4 represent the return movement of the beam from the right side of the picture to the left. This is called the horizontal *retrace.* When the beam reaches the bottom of the screen, it returns rapidly to the top during the time known as vertical retrace. Even though vertical retrace is quite rapid, several horizontal lines are scanned during this time. However, these retrace lines are normally "blanked out" so they do not appear on the screen. When the electron beam reaches the top of the screen, the scanning action is repeated.

We have shown how a single electron beam of varying intensity is able to trace a picture on the television screen. We have talked about the video signal that controls the intensity of the electron beam and we have mentioned the deflection yoke that causes the electron beam to scan the entire picture.

The video signal is produced by the television camera which scans the scene being televised at the same rate that the picture tube is being scanned. In order for the television receiver to produce the same picture as seen by the camera, both scanning actions must be exactly in step. In other words, when the camera starts to scan the upper left corner of a scene, the electron beam must begin to scan the upper left corner of the picture tube. This is accomplished by the horizontal and vertical *sync* signals which are transmitted along with the video signal. These sync signals control the scanning voltage applied to the deflection yoke in the receiver.

A color picture is produced in much the same way as a black-and-white picture. However, the color picture tube has *three* electron beams and three different types of phosphors on the inner face of the picture tube. One of these phosphors produces *red* light when struck by the electron beam, another produces *green* light, and the third phosphor produces *blue* light. When "mixed" properly, these primary colors can produce all other colors including white.

In most color picture tubes, the three color phosphors are deposited on the inside face of the picture tube in the form of dots. These dots, which are quite small and very close together, are arranged in a uniform pattern as shown in Fig. 6. Note that these dots are grouped in trios which are called *triads*. The color picture tube is designed so that each of the three electron beams will strike only one particular color of phosphor dots. In other words, the green beam will strike only the green dots, the red beam will strike only the red dots, and the blue beam will strike only the blue dots. We should point out that this is true only if the receiver is properly adjusted. These adjustments, known as the *purity* and *convergence* adjustments, are discussed in Chapter 2.



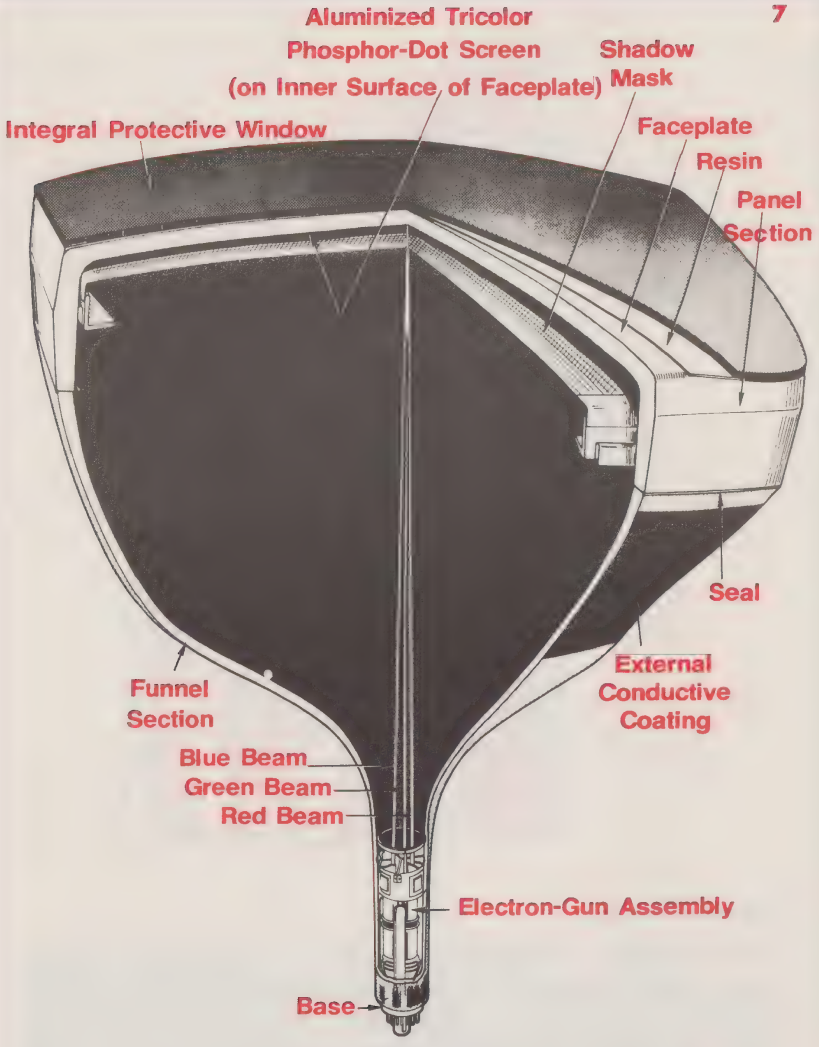
As the three electron beams simultaneously scan the television picture tube, each beam will illuminate its respective dot in a single triad. Since the human eye cannot distinguish the separate colors emitted from this small area at normal viewing distance, the individual lights from the three phosphors will blend to give the appearance of a single color. By controlling the intensity of each electron beam, the three primary colors in each triad can be "mixed" to produce any desired color. A cutaway view of a modern color picture tube is shown in Fig. 7. The purpose of the *shadow mask* just behind the face is to insure that all three electron beams strike their respective color dots within the same triad.

Several manufacturers now employ color picture tubes that have the color phosphors arranged in vertical stripes rather than triads of dots. The shadow mask is slotted which allows more electrons to strike the phosphors and thus produce a brighter picture. The three electron guns are arranged in-line rather than in the triangular arrangement employed by conventional color tubes. The electron beams pass through the slots in the shadow mask to strike their respective color stripes as shown in Fig. 8. Note that each beam energizes only a small area of the stripe at any instant. The diameter of the energized area is approximately equal to the width of the stripe.

THE TELEVISION RECEIVER

We have discussed the television picture tube and how it produces the picture. However, the picture tube is only one component of the complete television receiver that work together to produce the picture and the accompanying sound. The television receiver contains hundreds of components. Due to the wide variations in circuitry employed by television manufacturers, it would be an impossible task to describe the function of each component in a television receiver. Therefore, we will use a block diagram to group the various components into the basic sections of a television receiver.

Fig. 9 is a simplified block diagram of a black-and-white television receiver. Each block represents a functional sec-



tion of the receiver and the interconnecting lines represent the signal paths between the various sections. We will discuss the function of each section represented by the individual blocks in Fig. 9 in order to understand the overall operation of a television receiver. The additional color section will be discussed later in this chapter.

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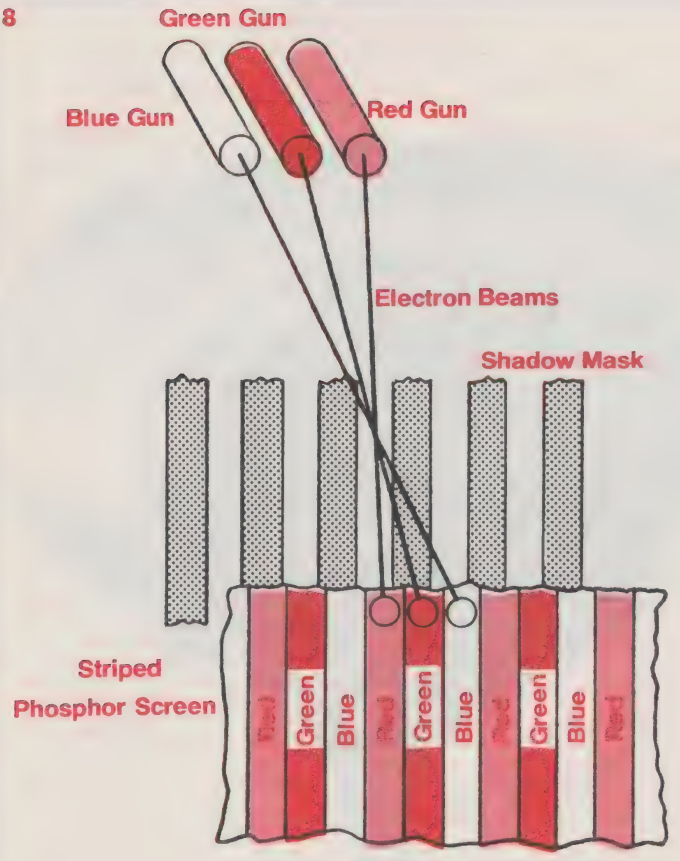
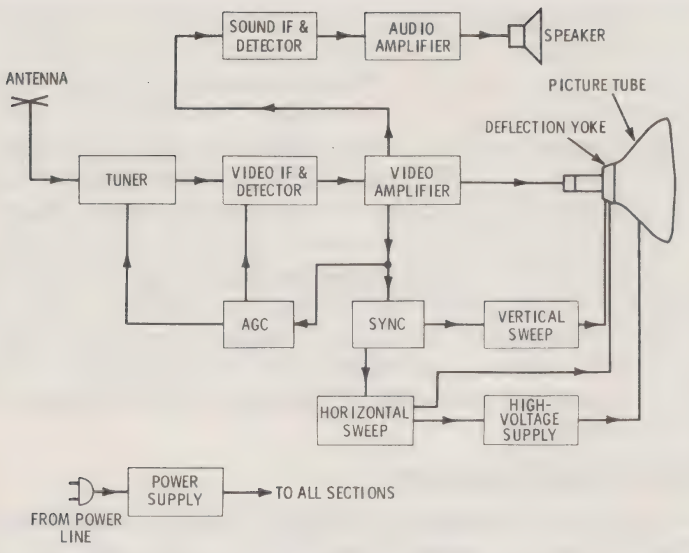


Tuner Block

The function of the tuner block is to select the desired channel and convert it to the intermediate frequency (i-f) so it can be processed by the video i-f amplifier. The tuner block also provides amplification for the incoming signal. Actually there are two tuners in the tuner block—the vhf tuner and the uhf tuner. The vhf tuner selects Channels 2 through 13, while the uhf tuner selects Channels 14 through 83.

The agc (automatic gain control) voltage applied to the tuner controls the amplification or gain of the r-f amplifier



portion of the vhf tuner. (The uhf tuner does not have an r-f amplifier. Amplification for the uhf signal is provided by the vhf tuner after the signal is processed by the uhf tuner.) When a weak station is tuned in, the agc voltage has no effect on the r-f amplifier. However, when a strong station is being received, the agc voltage reduces the gain of the r-f amplifier.

Video I-F and Detector Block

This section of the television receiver consists of two to four video i-f amplifiers and the video detector. Most tube-type television receivers have two or three video i-f amplifier tubes, while solid-state (transistor) sets often have up to four stages of video i-f amplification. The additional amplification provided by the video i-f amplifier section is necessary because the signal from the tuner is still too weak to operate the video and sound sections of the receiver. The signal processed by the video i-f amplifier contains not only the video (picture) information, but it also contains the sound and color information. In addition, the composite video i-f signal contains the sync pulses which control the horizontal and vertical sweep sections of the television receiver.

The agc voltages applied to the first video i-f amplifier controls the gain of that stage. Unless the signal being received is extremely weak, there is usually some agc voltage applied to the first video i-f amplifier. This results in pictures of about equal contrast range regardless of the strength of the incoming signal. The agc action is also necessary to prevent overloading and distortion due to very strong signals.

The function of the video detector is to convert the i-f signal to the original video signal produced by the television camera. In a black-and-white television receiver, the video detector also detects the sound i-f signal. In a color receiver, the sound i-f signal is detected prior to the last video i-f amplifier to prevent interference between the color signal and the sound signal.

Video Amplifier Block

After the video signal is detected, it must be amplified in order to drive the picture tube. This is the function of the video amplifier block. Most black-and-white, tube-type television receivers have a single video amplifier. However, most tube-type color receivers employ two or three stages of video amplification. Many solid-state receivers have up to four video amplifier stages. When more than one tube is used, the last stage in the video amplifier block usually is called the *video output* tube.

The composite video signal is also fed to the sync and agc blocks from the video amplifier block. This signal is usually amplified to some extent in the video amplifier block. In a black-and-white receiver, the sound i-f signal is also tapped off at the video amplifier block.

Sync Block

In order to properly produce a picture, the picture tube must be scanned exactly in step (synchronized) with the camera that is scanning the televised scene. This is accomplished by using the *sync pulses* in the composite video signal to synchronize the sweep voltages applied to the deflection yoke. The sync block separates the horizontal and vertical sync pulses from the composite signal so that they can be applied to the horizontal and vertical sweep sections of

the receiver. In some receivers, the sync block includes a sync amplifier to amplify the sync pulses.

AGC Block

The strength of the incoming signal from a television station is subject to many factors. These factors include: the power output from the transmitter, the distance between the transmitter and the receiver, and the weather. Even the signal from a single station is subject to variations in signal strength. Unless some method is used to compensate for these variations in signal level, the quality of the television picture would vary considerably.

The agc block produces a voltage which controls the gain (amplification) of the r-f amplifier and the video i-f amplifier according to the strength of the incoming signal. The sync-pulse portion of the composite video signal is used to develop this correction voltage. When a strong signal is received, the agc circuit reacts to the increased level of the sync pulses and produces a higher agc voltage. When a weaker signal is received, the agc voltage is reduced and the gain of the r-f amplifier and i-f amplifier is increased.

Vertical-Sweep Block

The function of the vertical-sweep block is to develop the sweep voltage applied to the vertical section of the deflection yoke. The vertical-sweep voltage produces the magnetic field which causes the electron beam to move from the top of the picture to the bottom and then back to the top. The vertical-sweep block includes a vertical oscillator which is controlled by the vertical sync pulses received from the sync block. The signal from the vertical oscillator is fed to the vertical amplifier stage where it is amplified and then applied to the deflection yoke.

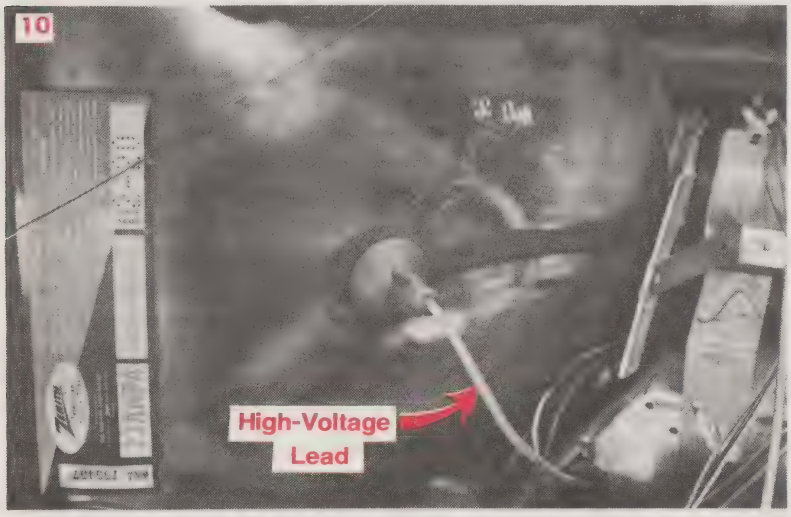
Horizontal-Sweep Block

The function of the horizontal-sweep block is to develop the sweep voltage for the horizontal section of the deflection yoke. The magnetic field produced by the horizontal deflection yoke causes the electron beam to move from left to right and then back to the left during retrace.

The horizontal-sweep signal is actually developed by the horizontal oscillator which is controlled by the horizontal sync signal. The sweep signal from the horizontal oscillator is then fed to the horizontal output stage where it is amplified. The amplified sweep voltage is then coupled to the horizontal deflection coils by the horizontal output transformer.

High-Voltage Supply Block

The high-voltage section of a television receiver is usually considered part of the horizontal-sweep block. An additional winding on the horizontal output transformer is used to develop a high pulse voltage which is converted to a high dc voltage by the high-voltage rectifier. The high-voltage rectifier may be a vacuum-tube rectifier or a special solid-state



rectifier. The output from the high-voltage rectifier is applied to the anode of the picture tube through a special high-voltage lead as shown in Fig. 10. This voltage ranges from 5000 volts for a small-screen black-and-white receiver to more than 30,000 volts for some large-screen color sets.

Sound I-F and Detector Block

After the sound i-f signal is removed from the composite video signal, it must be amplified and detected to recover the original audio signal. This is the function of the sound

i-f and detector block. It is very similar to the sound i-f and detector circuits used in an FM radio. This is because the television sound is also FM (frequency modulated). The sound i-f section usually consists of one or two amplifier stages. After the sound i-f signal is detected, it is then fed to the detector where it is converted to the original audio signal that was broadcast.

Audio Amplifier Block

After the audio signal is detected, it must be amplified in order to operate the speaker. The audio amplifier block usually consists of an audio amplifier stage and the audio output stage. However, some television receivers have only a single stage of audio amplification. When a single stage is used, it is usually called the audio output stage since it provides the amplified audio signal that is fed directly to the speaker. Most solid-state television receivers have three or four audio amplifier stages.

Power Supply Block

The function of the power supply is to convert the ac line voltage to the dc voltages which are necessary for the operation of the various circuits in a television receiver. The power supplies used in modern television receivers vary considerably. The dc voltage required for a solid-state receiver may be as low as 12 volts, while up to 400 volts dc may be required for a large tube-type color set.

The main component in the power supply is the rectifier, which converts the alternating current from the power line to direct current. While vacuum-tube rectifiers were used in early television receivers, they have been replaced in the last several years by solid-state rectifiers. Most of these solid-state rectifiers are not much larger than a kitchen-match head and yet are much more efficient and dependable than the old tube-type rectifiers.

THE COLOR TELEVISION RECEIVER

A simplified block diagram of a color television receiver is shown in Fig. 11. With the exception of the color block,

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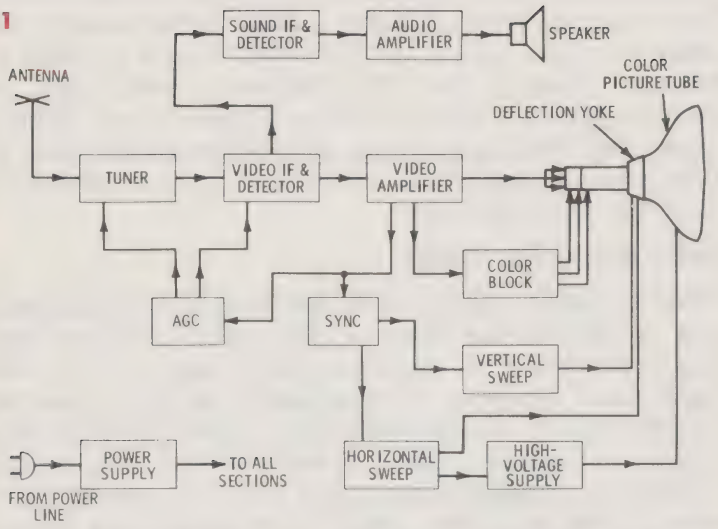


the color receiver is much like a black-and-white television receiver. This is to be expected, since the color receiver must perform all of the functions of a black-and-white receiver in addition to processing the three color signals which are applied to the picture tube. Another difference is that the sound i-f signal in a color set is taken from the video i-f block instead of the video amplifier block.

When a color program is broadcast, the signal which represents the three primary colors must be included in the composite video signal. The composite video signal containing the color information is fed to the color block from the video amplifier block. In the color block, the signal first passes through the chroma bandpass amplifier. The video and sync information is eliminated from the amplified color signal appearing at the output of the chroma bandpass amplifier.

The color signal is then fed to a color demodulator circuit along with a 3.58-MHz signal developed by the color oscillator circuit which is part of the color block. This 3.58-MHz signal is necessary in order to demodulate the color signal. The demodulator circuit extracts the three primary colors from the color signal and they are applied to their respective color amplifiers.

The color amplifiers are usually called *color-difference* amplifiers. This is because the video portion of the complete color-picture signal is missing at this point. The video signal is referred to as the Y signal in the technical language of color television. Therefore the color amplifier following the demodulator circuit are often called the G-Y, R-Y, and B-Y amplifiers. In some color television receivers, the video signal is applied to the color demodulators rather than at the picture tube. When this is the case, the amplifiers following the color demodulators process the complete color-picture signals. These amplifiers are simply called the green, red, and blue video amplifiers. From the color amplifiers the three color signals are applied to their respective electron guns at the picture tube. Regardless of whether the color signals and the video signal are combined at the picture tube or at the color demodulator circuit, the results are the same.

Included in the color block is the color-killer circuit. The function of this circuit is to turn off the chroma bandpass amplifier when a black-and-white program is being received. If the chroma bandpass amplifier were allowed to operate during black-and-white reception, any noise (snow) in the incoming signal would cause color specks to appear in the picture.

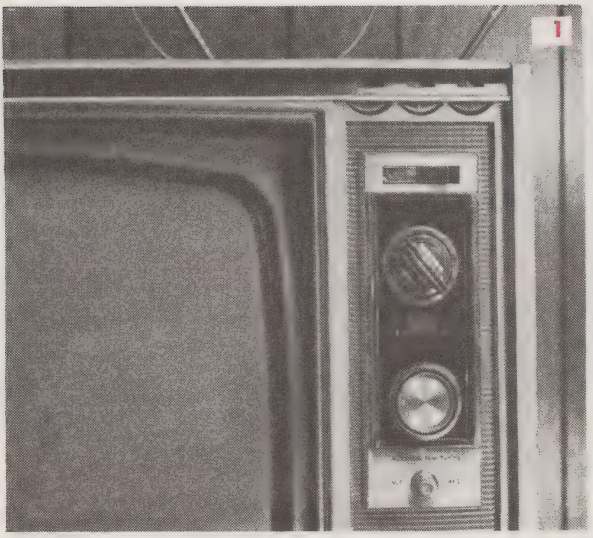
SECTION 2

Controls and Adjustments

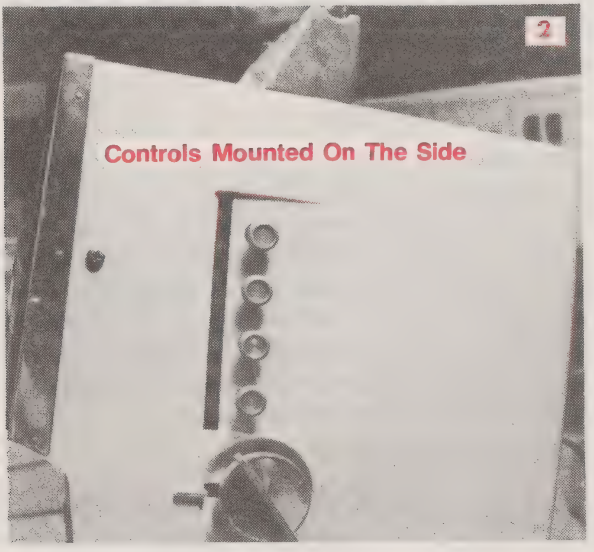
A television receiver has several controls which must be properly adjusted to obtain optimum performance. These controls can be divided into two categories—the *viewer-operated* controls and the *service* controls. The viewer-operated controls include those which are readily accessible to the viewer and are normally adjusted according to his or her preference. The service controls are usually located on the back of the set and often require a screwdriver or other tool for adjustment. These controls are normally adjusted at the factory and are seldom adjusted except when the receiver is being serviced by the television technician. Beginning with the viewer-operated controls, we will discuss the adjustment of each of these controls.

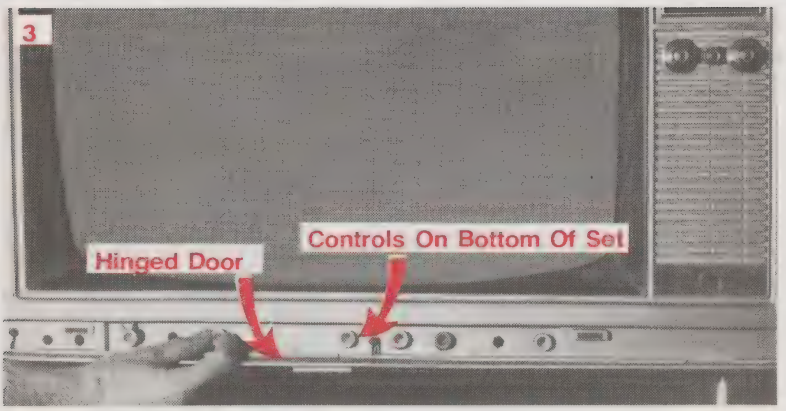
VIEWER-OPERATED CONTROLS

The viewer-operated controls are usually located on the front or side of the television set. Some of the viewer controls which are used least often may be hidden by a small hinged panel or even located on the back of the set. Fig. 1 shows the principal viewer-operated controls on the front of a color television receiver. The contrast, vertical-hold, and horizontal-hold controls for this particular receiver are located on the back of the set. Some television sets, such as the



small black-and-white model shown in Fig. 2 have their controls mounted on the side. Many of the viewer-operated controls for the color set shown in Fig. 3 are hidden behind the hinged panel just below the screen. The instruction booklet furnished with the television set will usually show the location of the various viewer-operated controls.





Volume Control

The volume control on a television receiver has the same function as it does on a radio or stereo amplifier. It determines the volume of the sound coming from the speaker(s).

Tone Control

The setting of the tone control determines whether the high or low audio frequencies are emphasized. In other words, the tone control is adjusted to accentuate the treble or bass portion of the sound. Many television receivers do not have a tone control.

VHF Channel Selector

The vhf tuner is tuned to a particular channel by switching the tuning elements in the various tuner circuits. This is the function of the vhf channel selector which is actually a switch with several contacts for each channel. When the television receiver is tuned to a particular channel, the proper tuned circuits are switched into each section of the tuner. When the channel selector is turned to the "UHF" position, the vhf tuner provides additional amplification for the i-f signal input from the uhf tuner.

Fine Tuning Control

By adjusting the fine tuning control, the video, color, and sound portions of the television signal are placed at the

proper position in the signal from the tuner. In a black-and-white receiver, the fine tuning control is adjusted for a compromise between best picture and best sound. In a color receiver, however, the adjustment is somewhat different. The fine tuning control is adjusted in the direction that gives more color until fine wavy curving lines (Fig. 4) appear in the picture. Then, the fine tuning control is turned in the

other direction until the wavy pattern just disappears. This should provide optimum tuning.

Most modern television sets feature preset fine tuning. This means that the fine tuning control can be set for each channel individually without affecting any of the others. The preset feature eliminates the need to adjust the fine tuning control each time the channel is changed. In order to adjust the fine tuning for many sets, it is necessary to either push in or pull out the control knob. This mechanically engages the fine tuning coil for the channel to which the selector is set. Many people are not able to properly tune their sets because they do not push in or pull out the fine tuning knob. In other sets, the fine tuning mechanism is automatically engaged when the knob is turned.

Automatic Fine Tuning Switch

Many late-model television receivers are equipped with an automatic fine tuning (aft) circuit that automatically adjusts the vhf tuner for optimum tuning. In order for this feature to work properly, the tuner must be manually fine-tuned within the "pull-in" range of the aft circuit. An aft switch is provided to turn off the aft circuit so that the fine tuning control can be adjusted manually. If your set has an aft switch and you cannot tune in an acceptable picture, turn off the aft circuit and manually adjust the fine tuning.

UHF Channel Selector

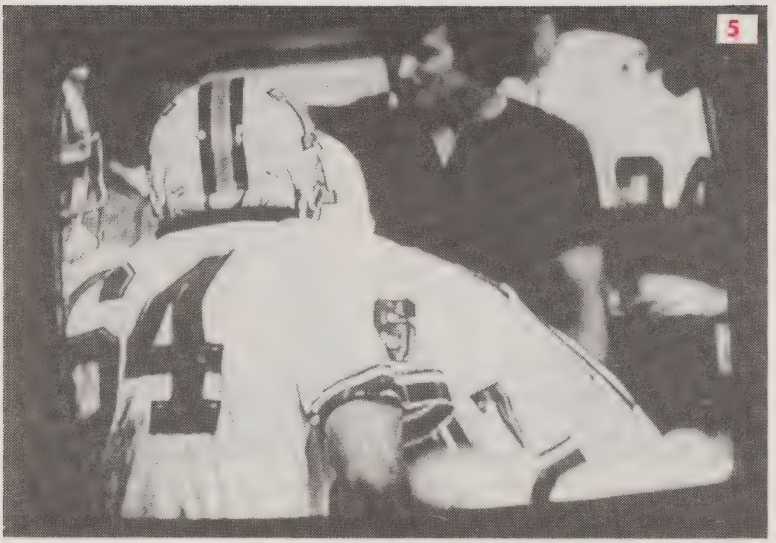
When an uhf channel is to be selected, the vhf tuner must be in the UHF or "U" position. Most uhf tuners are continuously adjustable like the fine tuning control for the vhf tuner. Since there are 70 uhf channels, the uhf channel indicator does not usually show every channel. Therefore, when tuning in an uhf channel, the uhf channel selector should be turned to the approximate location of the desired channel and then it can be accurately tuned while watching the picture. Some uhf tuners have switch-type tuning similar to the vhf tuners. With this type of uhf tuner, it is necessary to preset each position to the desired uhf channel.

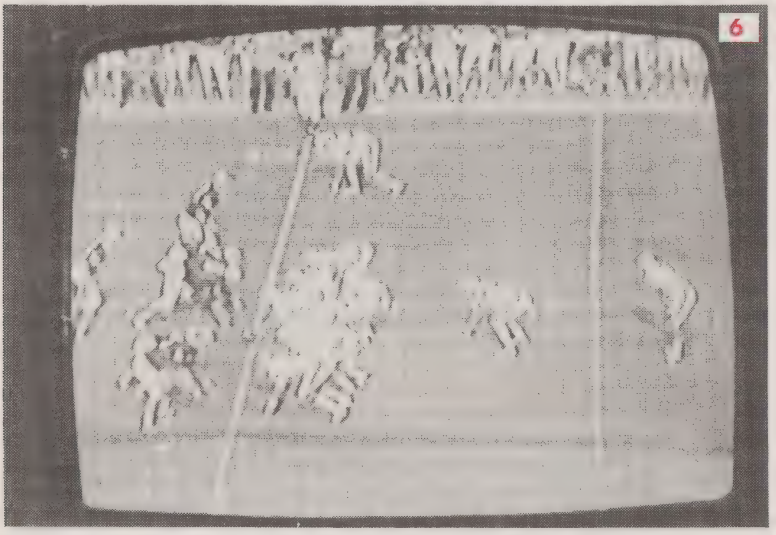
Brightness Control

The brightness control adjusts the intensity of the electron beam that illuminates the phosphor screen. Therefore, the overall brightness of the screen is determined by the setting of the brightness control. The correct adjustment for this control generally depends on the preference of the viewer and the lighting conditions in the room where the television set is located. If the brightness control is set too low, the picture will be dark and only the highlights will be visible as shown in Fig. 5. When the brightness control is set too high, the halftones will be lost and the picture will appear washed out as shown in Fig. 6.

Contrast Control

The adjustment of the contrast control determines the ratio of the brightest portion of the picture to the darkest





portion of the picture. In other words, the contrast control determines the ratio between black and white. When the contrast control is set too high, the intermediate tones will blend with the blacks and there will be a loss of detail as shown in Fig. 7. If the contrast is too low, the intermediate tones will blend with the whites and the black portions of

the picture will appear gray as shown in Fig. 8. When adjusting the contrast control, it is often necessary to adjust the brightness control at the same time.

Color Control

The color control determines the intensity of the colors. After the fine tuning control has been correctly adjusted, the color control should be set for normal color levels. Many people have a tendency to set the color level too high. When this is the case, the picture will lose much of its detail as shown in Fig. 9. The red hues will become predominant and tend to smear or appear ragged at the edges. A much more pleasing and natural picture can be obtained by keeping the color control set low.

Tint Control

The tint or hue of the colors displayed by a color television receiver are adjusted by the tint (hue) control. This control should be adjusted to produce proper flesh tones. If the tint control is adjusted too far in one direction, the flesh tone will become green. Turning the tint control too far in the other direction will produce blue flesh tones. When the tint

control is adjusted for correct flesh tones, the rest of the hues should also be correct. If you are unable to adjust the tint control for proper flesh tones, or some of the colors seem to be missing, there is probably a defect in the demodulator circuit.

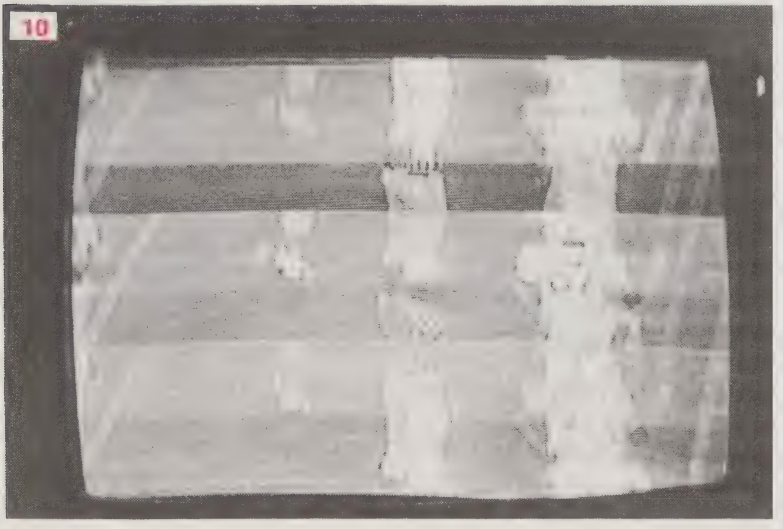
Since the phase of the color signal will vary from station to station, and often from program to program on the same station, the tint control may require frequent adjustment. Some color television receivers feature an automatic tint control circuit. The purpose of this circuit is to maintain normal flesh tones. This avoids the annoyance of having to adjust the tint control whenever the skin tones become blue or green. However, the flesh tones produced by such an automatic tint control circuit usually involve a compromise which results in slightly abnormal skin tones. More natural colors can usually be obtained by carefully adjusting the manual tint and color controls.

Vertical Hold Control

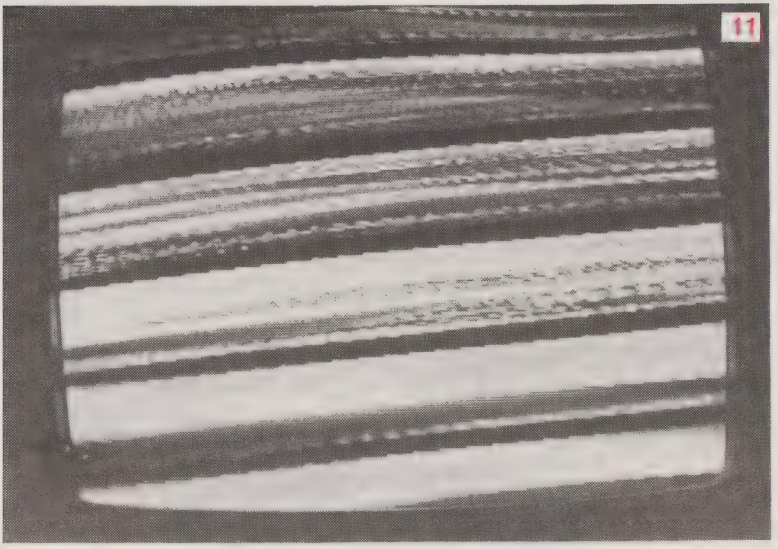
When the picture is rolling (Fig. 10), the vertical hold control should be adjusted to synchronize the vertical-sweep oscillator so that the picture will lock in sync. If it is impossible to stop the picture from rolling, or if it begins to roll again soon after the hold control is adjusted, there is probably a defect in the vertical-sweep circuit or the sync circuits.

Horizontal Hold Control

To check the setting of the horizontal hold control, switch the tuner off channel then back on. If the picture remains

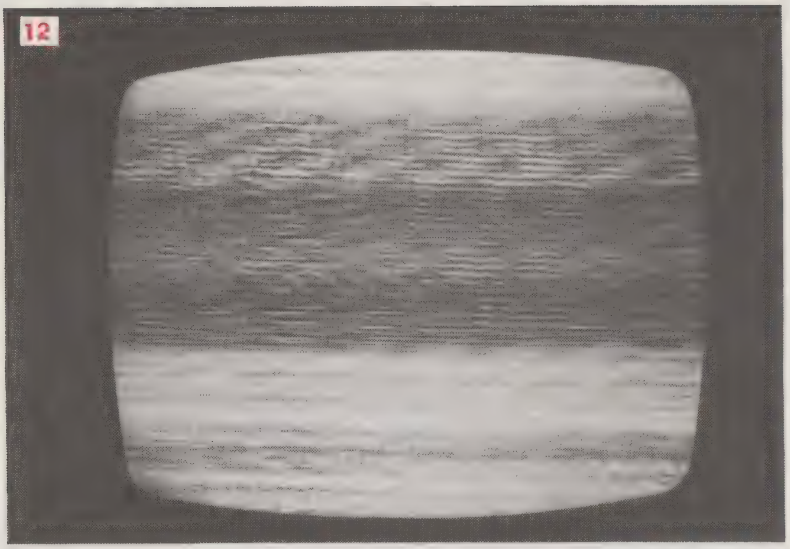


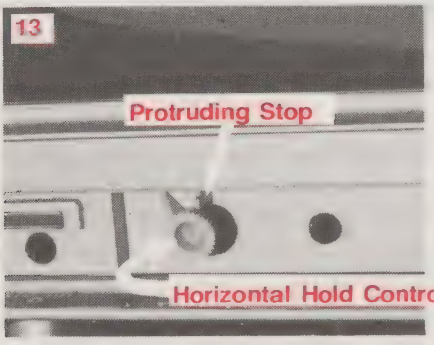
in horizontal sync, the hold control is adjusted properly. If the picture falls out of horizontal sync (Fig. 11), it will be necessary to readjust the control.



In some sets the horizontal hold control is actually a coil with an adjustable slug. The horizontal hold knob is attached to the slug so that when the knob is turned the slug moves in or out of the coil. With this type of arrangement, it is usually possible to turn the horizontal hold control several turns in either direction. If the control is turned far enough, the picture will eventually look like the illustration in Fig. 12. In this case, the hold control must be adjusted several turns to bring the picture back into horizontal sync.

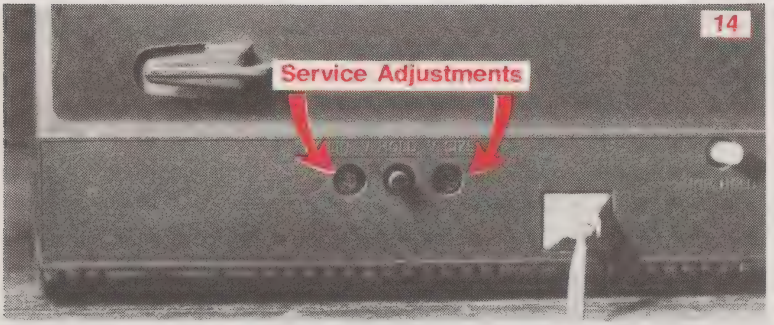
Some sets using the type of control just described employ some sort of stop so that the control cannot be turned more than one complete turn. This prevents the viewer from turning the horizontal hold control so far that it is difficult to bring the picture back into sync. Such a horizontal hold control is shown in Fig. 13. A protruding stop just above the control and a pointer on the knob prevent the control from being turned more than one full turn. If it is necessary to turn the control past the stop in order to synchronize the picture, the knob can be pulled out until it clears the stop.

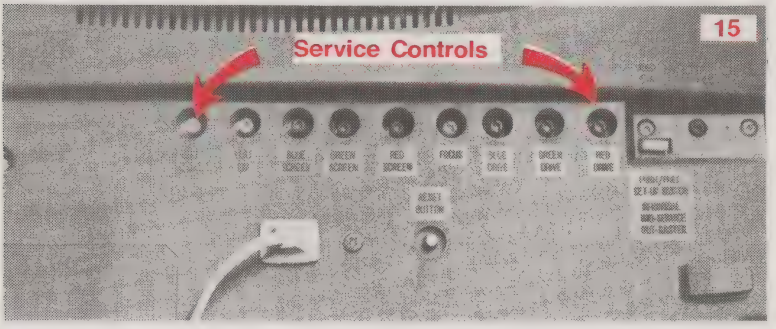




SERVICE CONTROLS

The service controls are those that are normally reserved for the television service technician. They are usually located on the rear of the chassis and are often recessed from the rear cover so that a screwdriver or other tool is necessary to adjust them. Fig. 14 shows the service adjustments for a black-and-white television receiver, while the service controls for a typical color set are shown in Fig. 15. The service controls that are discussed here are found on most television receivers.





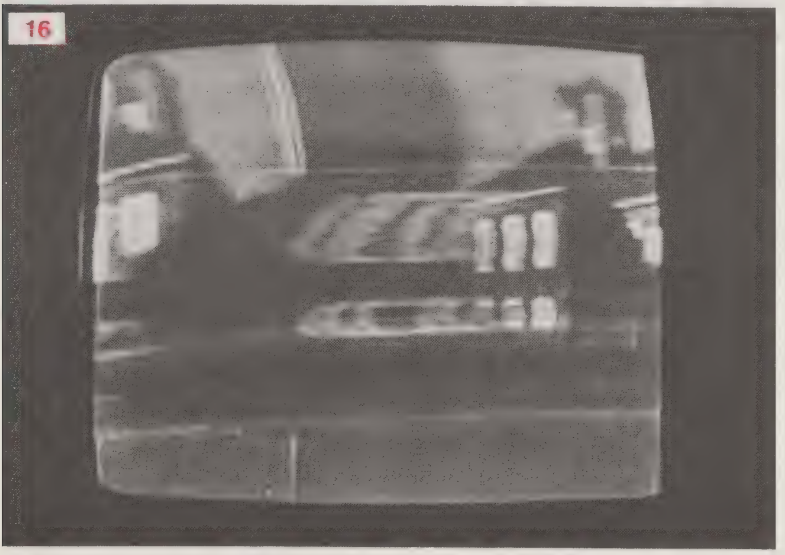
There are some specialized service controls which are used only with particular types of circuits. These controls usually require special adjustment procedures which should be performed by the television technician. The adjustment procedures given for the controls discussed in this chapter are general. The actual procedure recommended by the manufacturer for some of these controls may vary. Therefore, it is suggested that you adjust the service controls very carefully until you know what effect they have. Also, make these adjustments only when you think it is absolutely necessary. Leave the overall adjustments to a qualified technician.

Inside the television receiver are adjustable coils and transformers which are usually mounted inside small square aluminum cans. These coils and transformers are part of tuned circuits. *Never* attempt to adjust these components. Their adjustment is very critical and must be performed only by a qualified technician experienced in television alignment and who has the proper equipment to do it. Any attempt to

tamper with these coils could result in an *expensive* alignment job.

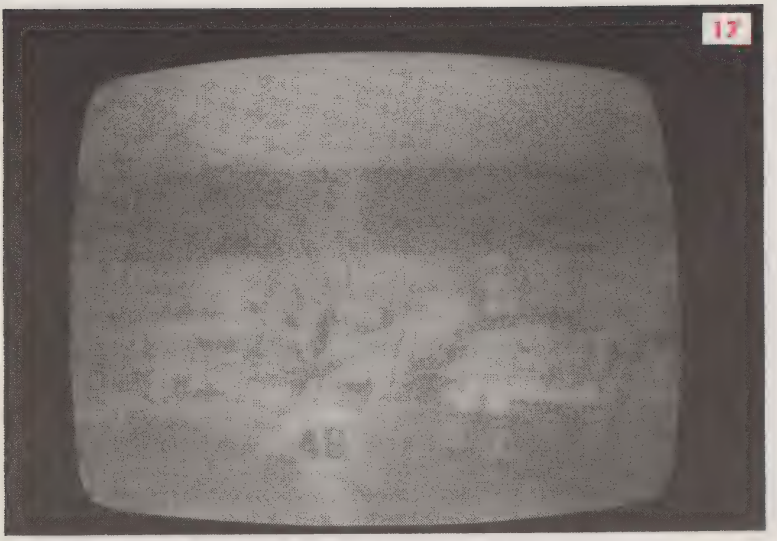
AGC Control

The agc circuit controls the gain of the receiver. If the agc is set too low, the circuits will overload on strong signals and the picture will be distorted and have excessive contrast as shown in Fig. 16. In some cases, the picture will com-



pletely blank out. If the agc is too high, the gain of the receiver will be severely reduced and the picture will appear washed out as shown in Fig. 17. To adjust the agc control, tune the set to the strongest channel in the area and turn the control until the picture distorts or bends and then turn the control in the other direction to just past the point where the distortion clears up. The actual effect of the agc control will vary from set to set. Therefore, it may be necessary to use a trial-and-error procedure to find the optimum setting for the control.

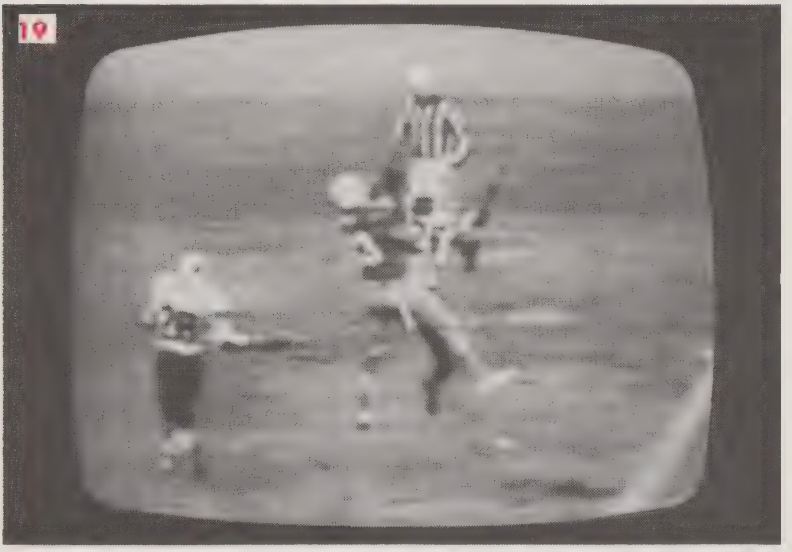
Some television receivers also employ an *agc delay* control. To adjust the agc delay control, switch the tuner to a moderately strong channel and adjust the control for the least amount of snow in the picture. If the control has no

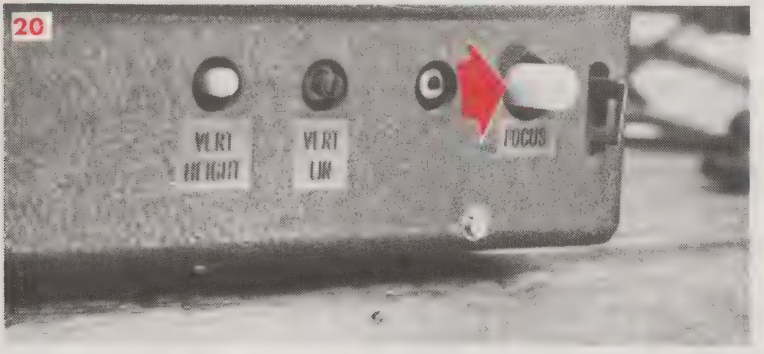


effect, return it to the original setting. If the agc delay voltage is set too high, the picture may appear snowy as shown in Fig. 18.

Focus Control

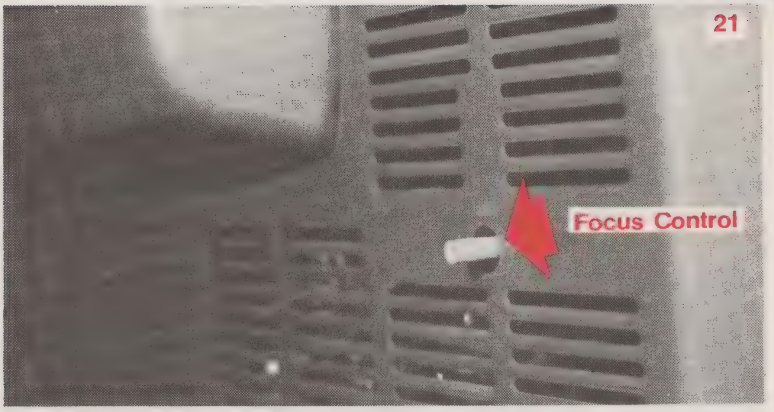
If the picture is fuzzy or blurred as shown in Fig. 19, it may be necessary to readjust the focus. Fig. 20 shows one



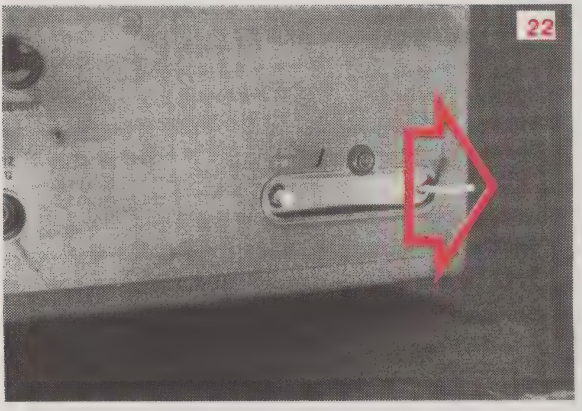


type of focus control. This focus control is actually an adjustable coil which can be turned several full turns. When adjusting this type of control, it may be necessary to turn the knob a few turns in either direction to obtain optimum focus. When adjusting the focus, the color control should be set at minimum and the brightness and contrast controls should be set for normal viewing.

Another type of focus control is shown in Fig. 21. This is an ordinary potentiometer-type control which has an adjustment range of less than one full turn. A slight readjustment of this control will have much more effect on the focus than



the first type of focus control. Fig. 22 shows still another type of focus control. This is a focus coil with a slim plastic shaft which is either pushed in or pulled out to adjust the focus. To lock the adjustment, a plastic cam is rotated against the shaft. The cam may be turned with a screwdriver to unlock the control. Some early color sets using this type of control did not have the lock. Therefore, it was very easy to knock the control out of adjustment when moving the set. The same thing can happen with the later models if the focus shaft is not locked.



22 A

Plastic Shaft
Push-Pull To
Focus

Most black-and-white television receivers, and some color sets, employ a fixed focus. When this is the case, there is no focus control. If the focus becomes bad in these receivers, a service technician will have to be called.

Vertical Height and Linearity Controls

These two controls adjust the sweep signal applied to the vertical deflection coils. If your picture does not fill the top or bottom of the screen, there is a good possibility that one of these controls is out of adjustment. The vertical linearity control usually affects the top of the picture, while the height control usually adjusts the bottom of the picture. However, some manufacturers reverse the roles of these two controls. Also, the height control may be called the *vertical size* control on some sets.

When adjusting these controls, it may be necessary to experiment a little to determine the effect of each control. In many television receivers, both the top and bottom of the picture will be affected to some extent by either control. The main idea is to completely fill the screen and, at the same time, obtain a properly proportioned picture from top to bottom. If there is too much deflection at the top of the screen, the upper portions of the picture will appear stretched as shown in Fig. 23. If there is insufficient deflection, the top

of the picture will be compressed as shown in Fig. 24. Improper adjustment of the control that affects the bottom of the screen (usually the height or vertical size control) will

produce the same results at the bottom of the picture. Fig. 25 shows the bottom of the picture stretched, while in Fig. 26 the bottom of the picture is pulled up.

Color-Killer Control

The color-killer circuit turns off the color while a black-and-white program is being received. The color-killer control is used to establish the correct operation of this circuit. If

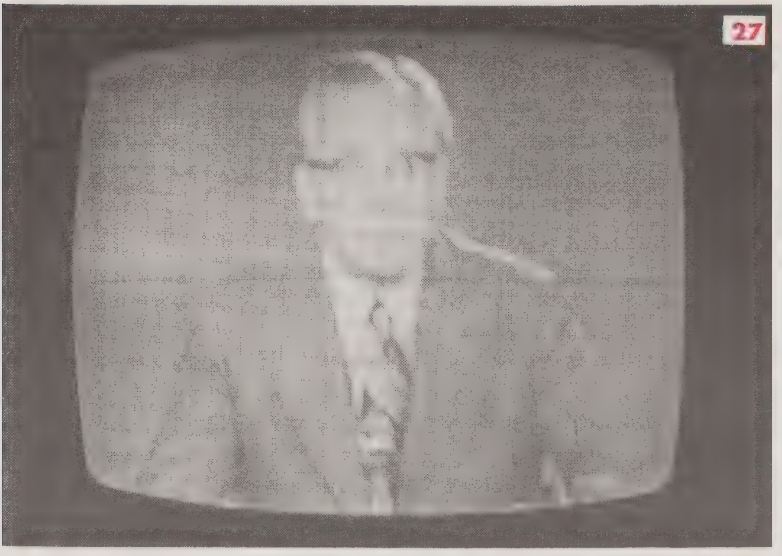
the color-killer control is set too high, the color will be missing on some or all channels. When the control is set too low, colored specks will show up in a black-and-white picture.

The following procedure is used to set most color-killer controls. Turn the channel selector off channel to obtain snow. Advance the color control to maximum. Turn the color-killer control in the direction that produces colored snow, then turn the control in the other direction until the color just disappears from the snow. Check all channels in your area to make sure that the color is not missing. If the color is missing on any channel, turn the color-killer control in the direction that causes the color to return. In most sets, the color-killer control is turned clockwise to eliminate the color snow. Of course, if the control is turned too far clockwise all color will be eliminated. In other sets, the color is removed when the color-killer control is turned counterclockwise.

Brightness Range Control

This control may be called the *brightness limiter* control by some manufacturers. It is usually found only on color television receivers. If the brightness is set too high on some sets, it can cause damage to the picture tube or the high-vol-

tage section. The purpose of the brightness range control is to limit the maximum setting of the viewer-operated brightness control. When the brightness range control is set too high, the picture will expand and tend to go out of focus (Fig. 27) when the brightness control is turned to maximum.



If the brightness range control is set too low, it may not be possible to obtain sufficient brightness. However, there are several other possible causes for loss of brightness. Unless you have good reason to suspect that the brightness range control may have been turned, do not adjust this control to correct a dark picture. In some sets, the adjustment of this control is rather critical and should be left to a qualified television service technician.

Peaking Control

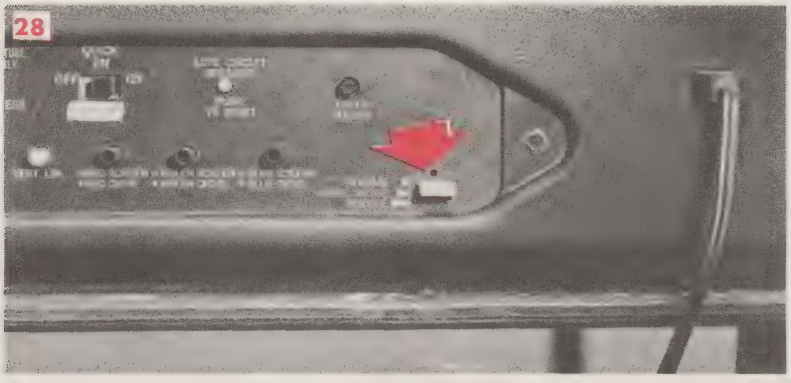
This control is found on many color television receivers. On some sets, the peaking control is located on the front panel. When the control is set for maximum peaking, the picture becomes crisp with small detail well defined. With the peaking control set at minimum, the picture is softer. The peaking control should be adjusted according to the preference of the viewer.

Red, Blue, and Green Screen Controls

In order for a color picture tube to produce proper colors, all three electron guns must operate at approximately the same level. The function of the screen control is to set the operating level of each of the three electron guns. If one color seems to be predominant in the background of your picture, it is quite likely that the screen controls need to be adjusted. Turn the color control all the way down and look at the picture. It should appear black-and-white. If the picture shows a color cast, the screen control should be readjusted. The procedure for adjusting the screen controls is known as the *gray-scale* adjustment.

The following procedure can be used to adjust the screen controls on most sets. Turn the color control and the contrast control to minimum. Reduce the brightness until the picture is barely visible. Turn all three screen controls completely counterclockwise. The screen will probably be completely dark after the screen controls are turned down. Turn the red screen control clockwise until a dim red picture is just visible. Use the same procedure for the other two screen controls. Turn up the brightness control to normal. If any color is predominant, reduce the setting of that screen control. If the picture is too dark, advance each screen control slightly to obtain a normal black-and-white picture.

Many color sets have a *service switch* (Fig. 28) which can be used while adjusting the gray scale. Move the service switch to the "service" position. This should reduce the picture to a thin horizontal line across the center of the televi-



sion screen. The brightness control will probably have no effect on the brightness of the line. If it does, reduce the brightness setting until the line is barely visible. Turn the three screen controls completely counterclockwise. One at a time, turn the screen controls clockwise until each produces a barely visible line on the television screen. If any of the screen controls fails to produce a line, refer to the adjustment information for the *kine bias* control. Return the service switch to the normal position. You should now be able to obtain a normal black-and-white picture. If not, the adjustment was not made correctly or there is a defect in the set.

Kine Bias Control

This control determines the overall operating level of the color picture tube. Some manufacturers employ a three-position switch in place of a control to adjust the kine bias. The word "kine" refers to the picture tube which is called the kinescope or the cathode ray tube (crt). In some sets, this control is called the crt bias control. The kine bias control should be set high enough to permit all three screen controls to be properly adjusted.

Red, Blue, and Green Drive Controls

The drive controls are used to make the gray scale adjustments for the picture highlights. Many color sets have only two drive controls—usually the red drive control is omitted. To set the drive controls, turn the brightness control to maximum and adjust the drive controls to eliminate coloring in the bright areas of the picture. Some manufacturers recommend that at least one of the drive controls be left in the maximum clockwise position.

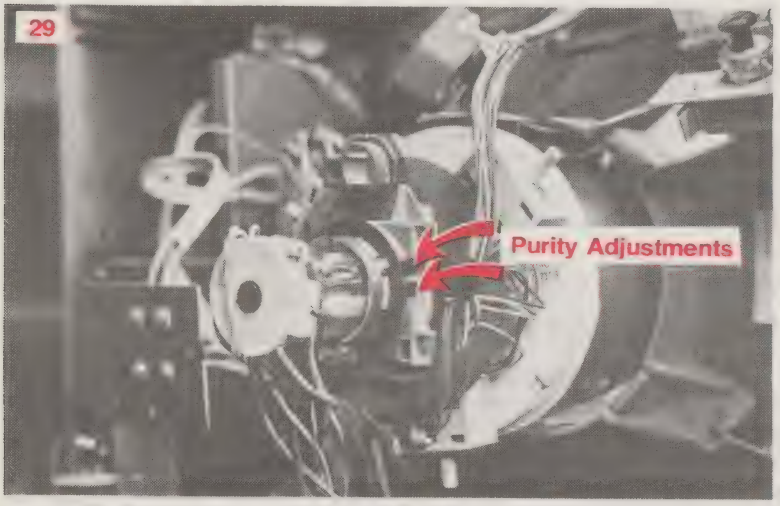
High-Voltage Control

A high-voltage control is found only on color television receivers. You should *never* attempt to adjust the high-voltage control for any reason. Improper adjustment of this control can result in excessive X radiation from the picture tube and, in addition, may damage the picture tube. Excessive high voltage may also result in damage to components in the horizontal-sweep and high-voltage circuits. The high-voltage

control should be adjusted only by a qualified service technician who has the proper equipment to measure the high-voltage and who is familiar with the adjustment procedure for your particular set.

Purity Adjustments

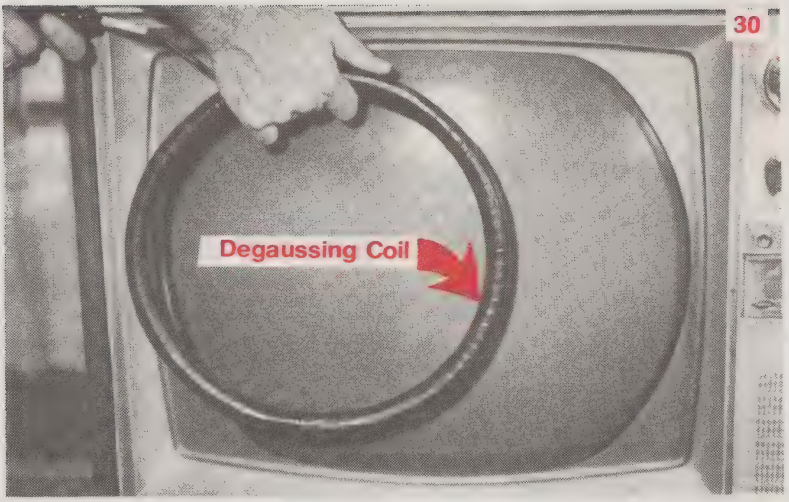
The purpose of the purity adjustments is to properly aim the three electron beams. The usual symptoms for misadjusted purity are color blotches on the television screen. The purity is adjusted by means of the two magnetic rings shown in Fig. 29. This adjustment is rather involved and must be made with the back off of the set and the power turned on.



For this reason, *the purity adjustments should be performed only by the television technician.* When making the purity adjustments, it is often necessary for the technician to demagnetize the picture tube. This is accomplished with a large coil which is called a *degaussing* coil. The coil is plugged into the ac power outlet and waved in a circular motion around the front of the picture tube as shown in Fig. 30.

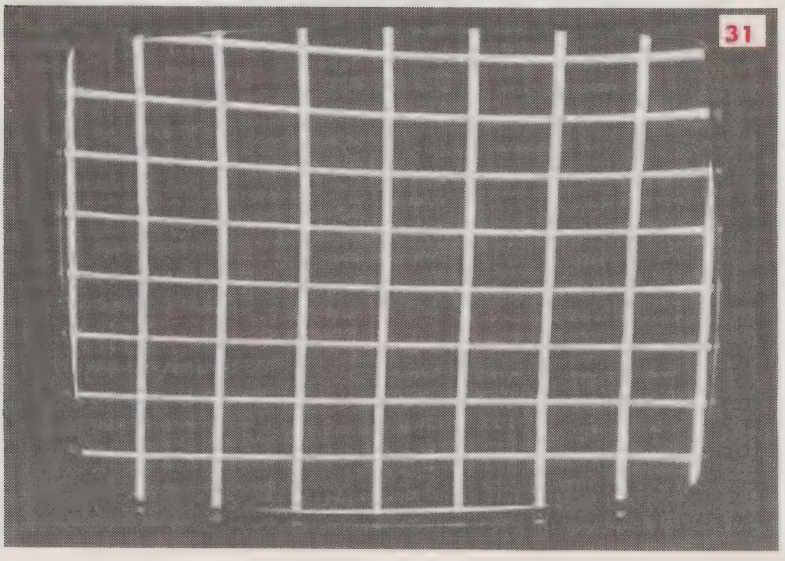
Convergence Adjustments

The convergence adjustments are complicated and tedious. The procedure requires a good deal of skill and expe-

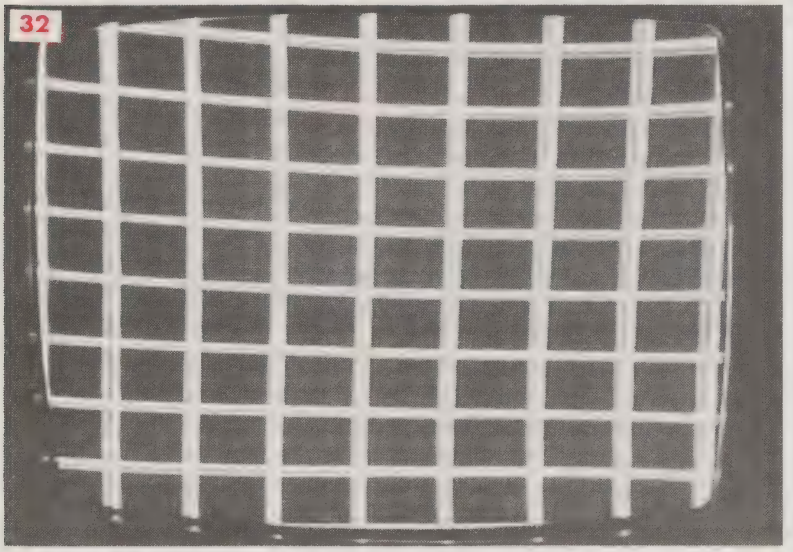


rience to properly converge a color television receiver. For this reason, the convergence adjustments should be performed only by a qualified technician.

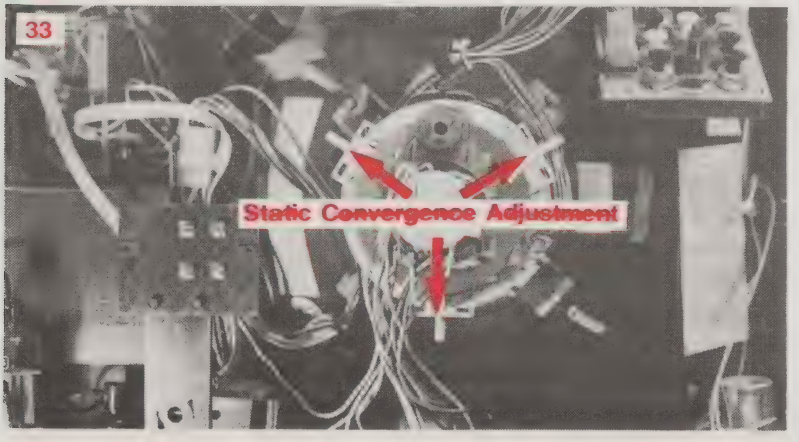
When making the convergence adjustments, the technician uses an instrument called a color-bar generator to display a crosshatch pattern on the screen as shown in Fig. 31. Some technicians prefer to use a dot pattern for the stat-



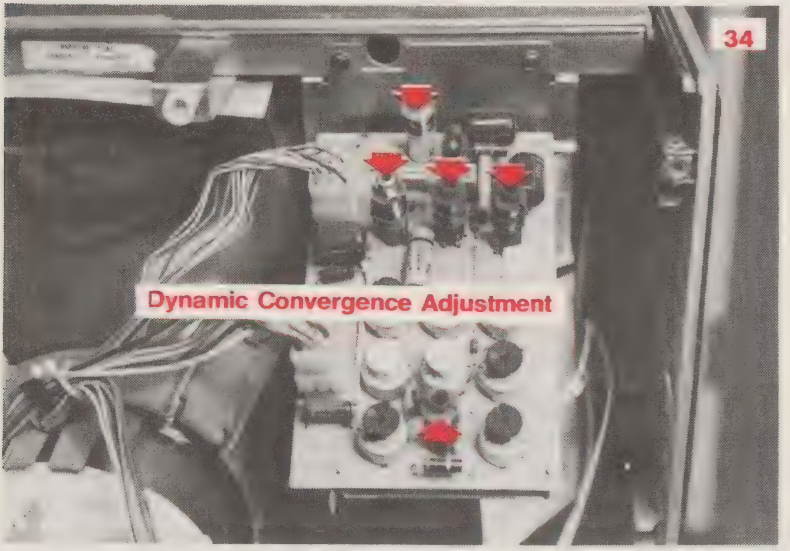
ic convergence adjustments. When the three beams are properly converged, the three color patterns will come together to produce a single white pattern. In Fig. 32, only two of the patterns are converged and the other one is displaced to the right.



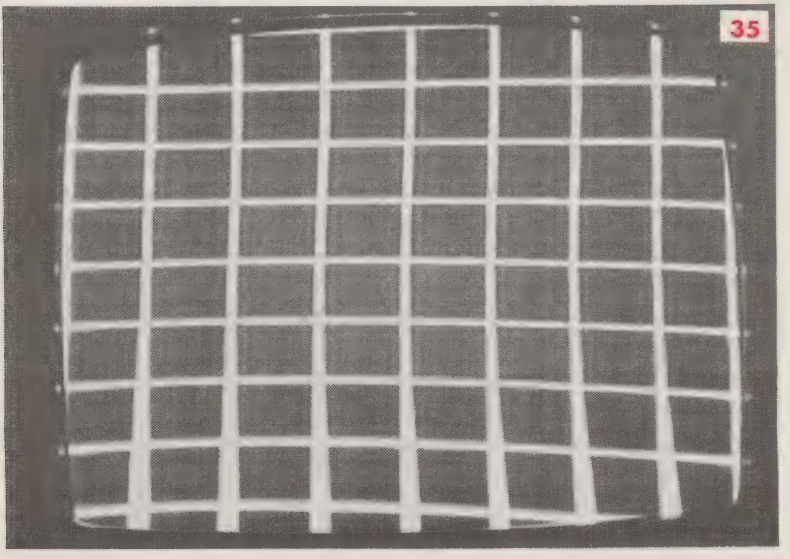
After the center of the screen is converged (by static convergence adjustment, Fig. 33), the technician must converge the outer edges of the screen. This is called the dynamic convergence adjustment and is accomplished with the dy-



namic-convergence controls shown in Fig. 34. Each of the controls affect the convergence in a given area of the



screen. Fig. 35 shows the result when the red and green vertical lines are out of convergence at the bottom of the picture.



SECTION 3

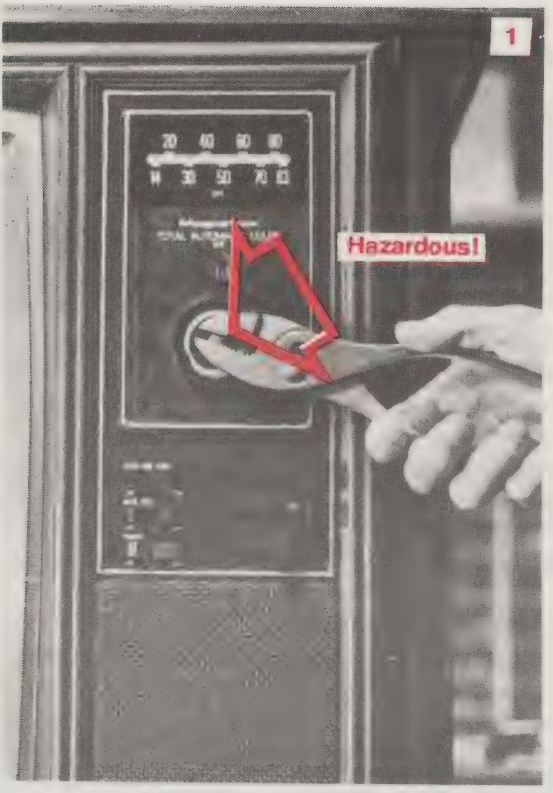
Minor Repairs and Maintenance

Some of the defects that occur in a television receiver can be corrected by fairly simple repairs. Most of these repair procedures can be performed by the set owner who has knowledge of the required techniques. In this chapter, we will discuss some of the repair and maintenance techniques that should help you avoid unnecessary service calls.

SAFETY CONSIDERATIONS

A television receiver is designed to operate safely as long as it remains intact. This means that the correct knobs must be installed on each control shaft and the back or cover must be securely fastened in place. Some set owners may use pliers in place of a broken knob (Fig. 1) or operate the set with the back off for one reason or another. Either one of these practices can be very hazardous.

Many television receivers have the metal chassis (often called "ground") connected to one side of the power line. In almost every home-wiring installation, the neutral side of the power line is connected to the cold water pipes. Also, the metal cabinets of most major appliances are connected to the neutral side of the power line through some sort of "ground" connection. Depending on which way the tv power cord is plugged into the ac receptacle, the chassis may be



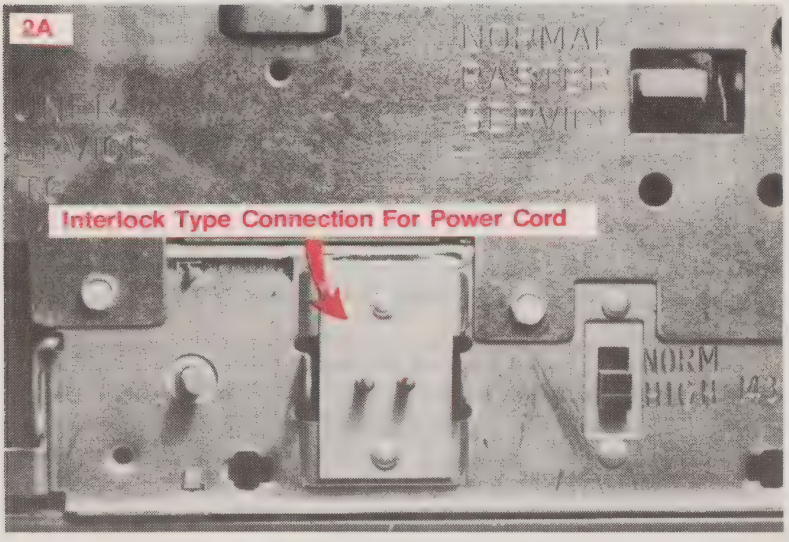
connected either to the neutral side of the power line or to the "hot" side. Often, television receivers employ metal control shafts which are electrically connected to the chassis. If the power cord is plugged in so that the chassis is connected to the "hot" side of the line, the full line voltage will be present between the metal control shaft and any grounded object such as a water pipe, a heating duct, or a grounded appliance.

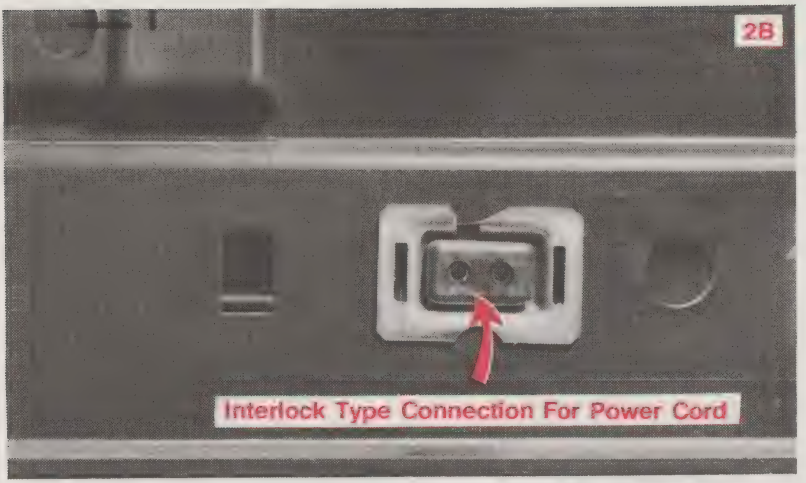
This is why it is dangerous to operate a television set with a knob missing. If the television receiver has a power transformer, the chassis is usually isolated from the power line. When metal knobs are used, the control shaft is either plastic or is insulated from the chassis. Also, when the chassis is connected to one side of the power line, the antenna rods

and metal cabinet trim must be insulated from the chassis to prevent the possibility of electrical shock.

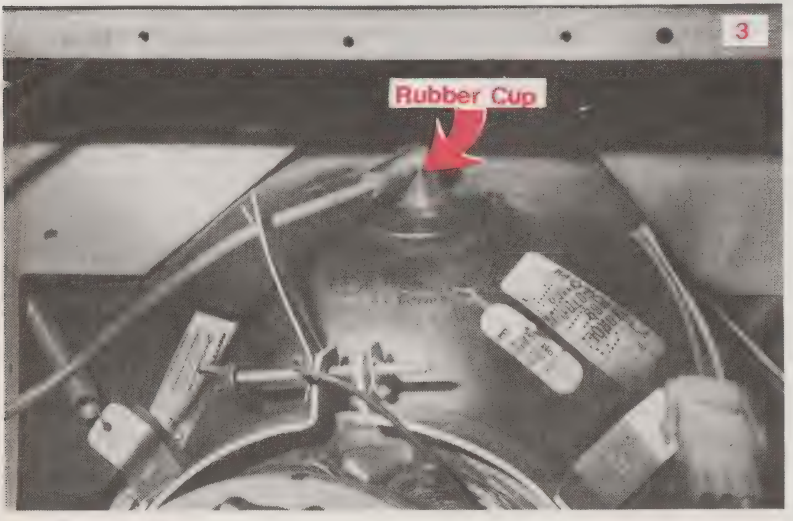
When a television receiver is operated with the back or rear cover removed, there is also the possibility that someone could receive a very serious electrical shock. The high voltage applied to the anode of the picture tube may be as high as 30,000 volts in some sets. Contact with this high voltage could produce a serious burn or, in some cases, a fatal shock. Also, the involuntary muscular response caused by contact with this high voltage could lead to a serious injury. Even more lethal are the power-supply voltages which are exposed at various points inside the receiver. Although these voltages rarely exceed 400 volts, the higher current can result in electrocution. It is especially dangerous to operate a television set with the back off where children are present. All television receivers have an *interlock* type connection (Fig. 2) for the power cord so that the set cannot be operated with the back off. *Do not try to defeat this interlock protection.*

Some of the service procedures discussed in this chapter require the removal of the back from the television receiver. However, none of these procedures require that the power be on when the back is removed. If it is necessary to apply

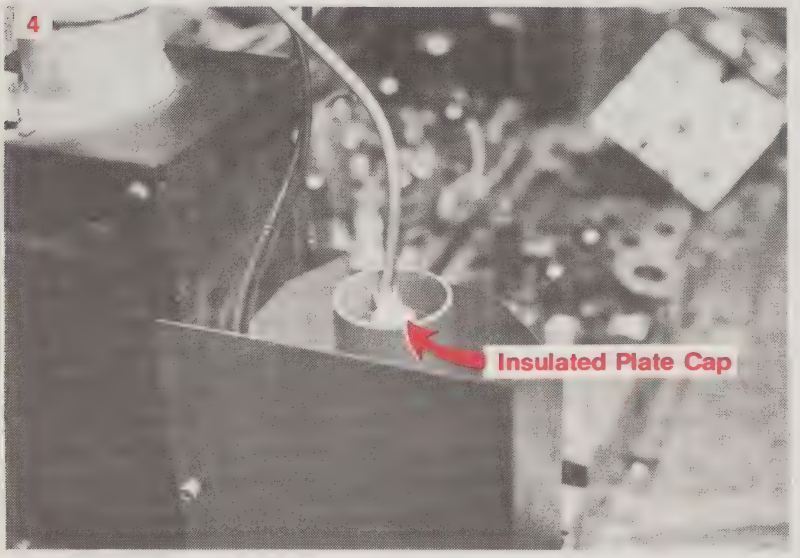




power to check the results of any of these repairs, replace the back. Sometimes, even with the power disconnected, you can receive a painful shock. The picture tube acts as a large capacitor and can store a high-voltage charge, sometimes for days. The connection to the high-voltage anode of the picture tube is usually protected by a rubber cup as shown in Fig. 3. As long as you do not disturb this cup, there is little danger of discharging the picture tube.



Some color receivers use a shunt-type high-voltage regulator tube. This type of regulator is characterized by the large insulated plate cap shown in Fig. 4. The plate cap lead for this type of regulator is connected directly to the high-voltage anode of the picture. If you remove the plate cap for any reason, you may receive a shock from the charge on the picture tube.



The metal enclosure shown in Fig. 5 is sometimes referred to as the "high-voltage cage." It usually contains the high-voltage transformer and the high-voltage rectifier tube. The main function of the high-voltage cage is to prevent the X rays emitted by the high-voltage rectifier tube from being radiated outside the set. Make sure that the high-voltage cage is securely in place before power is applied to the set.

It is important that your television receiver has adequate ventilation to prevent overheating, especially tube-type sets. This is the purpose of the holes or slots in the rear cover. Many portables or table models have wrap-around rear covers with slots in the top. Make sure that these slots and other ventilation holes are not covered with newspapers, magazines, clothing, or anything else that would prevent

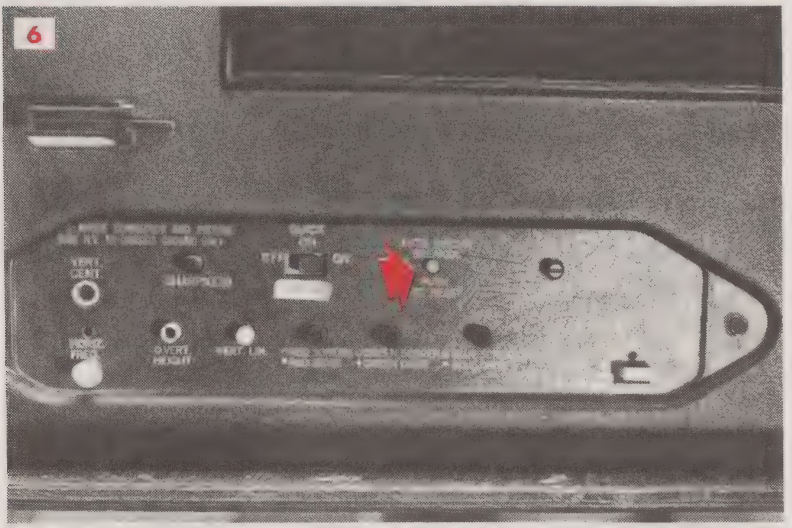
proper air circulation. If your set is a remote-controlled model, do not cover it in any way as long as it is plugged into the power line. It is not uncommon for these sets to be turned on by extraneous noise having the same frequency as the remote transmitter.

Also, make sure that the ventilation holes are not clogged with dirt and dust. It is a good idea to periodically clean the holes with the brush attachment on a vacuum cleaner. At the same time, vacuum the screen on the bottom of the receiver. Do not operate the set too close to radiators or other heat outlets. While overheating can cause extensive damage to a television receiver, it has also been the cause of some very serious fires. Therefore, see to it that your set has good air circulation at all times.

Make certain that children never push or drop objects into the ventilation holes. This could result in a serious electrical shock or fire due to a short circuit. Never set drinks or other liquids on top of the television cabinet, especially sets with ventilation slots in the top portion of the rear cover. Fluids spilled into the set can cause short circuits and fire, besides damaging the set. For the same reason never expose the set to rain or excessive moisture.

CIRCUIT BREAKERS AND FUSES

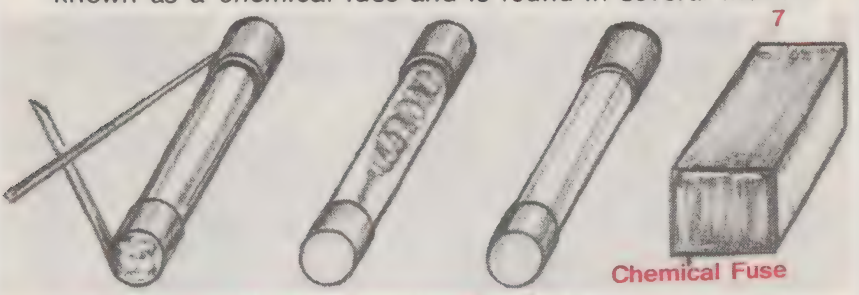
All television receivers employ some sort of fuse device to protect the power supply from shorts and overloads that might occur in other sections of the receiver. One of the most common types of fusing device found in modern sets is the circuit breaker shown in Fig. 6. The red circuit-breaker



button is usually located on the back of the set near the power cord. While the purpose of the circuit breaker is to protect the power supply from internal shorts and overloads, it may occasionally trip due to external causes such as lightning or voltage surges on the power line.

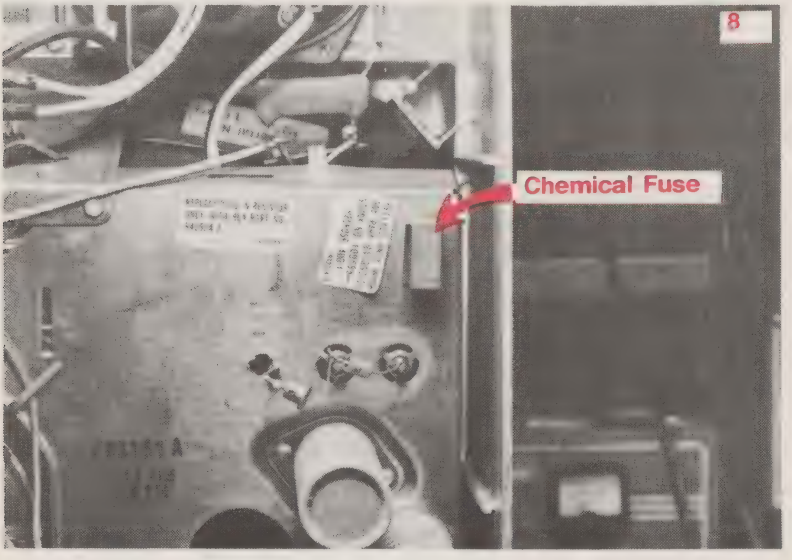
If your set is dead (no sound or picture) and it uses a circuit breaker, try to reset the breaker. Push in the breaker button and then release it quickly. If the breaker trips immediately, try it once more. If the breaker trips again, there is probably a short circuit somewhere and the set will have to be serviced. If the breaker holds and the set returns to normal operation, there is a good chance that the breaker was originally tripped by an external power-line surge or lightning. If the breaker holds but there is still no picture, there is probably a defect that will require the services of a television technician.

Some sets may use a fuse rather than a circuit breaker. Fig. 7 shows some of the types of fuses used in television receivers. The rectangular plastic unit shown on the right is known as a *chemical fuse* and is found in several modern



Types Of Fuses Used In Television Receivers.

sets. Fig. 8 shows a chemical fuse installed in a tv chassis. Like a circuit breaker, a fuse may blow due to an external cause. However, it is not as easy to replace a fuse as it is to reset a circuit breaker. If the fuse was blown due to a defect in the receiver, a replacement fuse will probably blow immediately. This can be rather expensive, especially if the set uses the chemical-type fuses costing almost a dollar each. One electronic parts manufacturer produces plug-in



circuit breakers (Fig. 9) to replace the chemical-type fuses. The circuit-breaker type replacements can be used in sets that have frequent fuse failures due to line surges and other external causes. While repairing a television with a blown fuse, the service technician will often use the breaker-type replacement in place of the regular fuse until he finds the defect that caused the fuse to blow.

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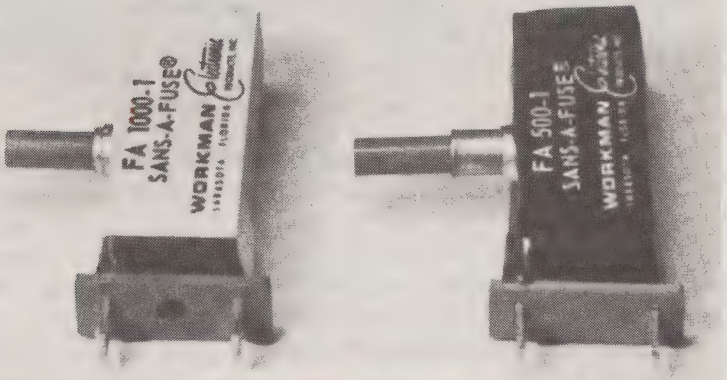


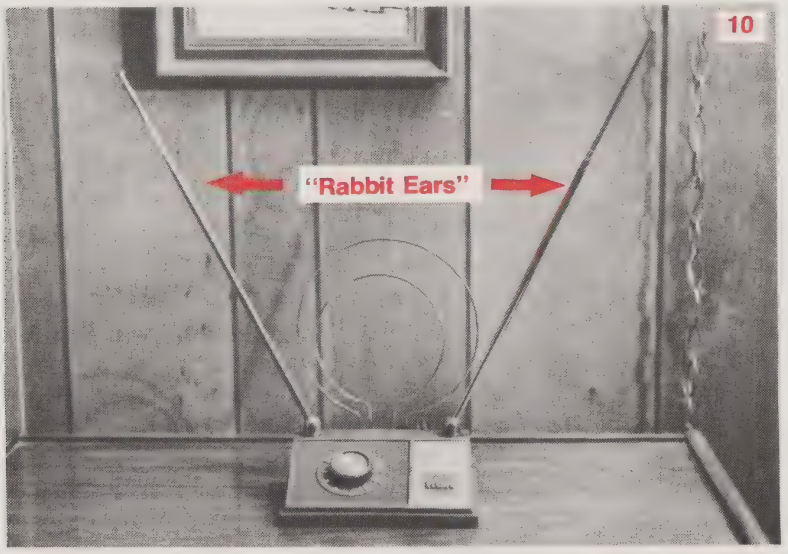
Plug-In Circuit Breakers

Some television receivers use more than one fuse. In fact, some color receivers have as many as five. Additional fuses are often used to protect individual circuits, such as the horizontal sweep circuit. When these fuses blow, it is usually due to a defect that will require the services of a television technician. The set owner should generally limit his attention to the fuses or circuit breaker that protect the power supply. *Never* replace any fuse in a television receiver with a fuse that has a higher current rating than the original. The result could be an expensive repair job. The chemical-type fuses use differently shaped prongs for each current rating, making it almost impossible to substitute a fuse with the wrong rating. The chemical fuses are also color coded as a means of identifying the current rating. Therefore, when replacing a chemical fuse, make sure that the replacement fuse is the same color as the original before attempting to install it.

ANTENNA PROBLEMS

The condition of the antenna is a very important factor for good television reception. Regardless of how well a television receiver is tuned, an inadequate or misadjusted antenna will result in unacceptable performance. Antennas are generally classified into two categories—indoor antennas and outdoor antennas. Indoor antennas include the "rabbit-ears" type shown in Fig. 10 and the built-in dipole antennas found on most portable sets (Fig. 11).

While an indoor antenna will provide satisfactory reception in most metropolitan areas, an outdoor antenna system usually provides superior performance. A typical outdoor antenna installation is shown in Fig. 12. This system actually consists of three separate antennas, each designed for a specific channel and aimed in the direction of the transmitter. This popular arrangement eliminates the need for an antenna rotator which must often be used with an all-channel antenna. A typical antenna rotator and control box is shown in Fig. 13. When this type of installation is used, it is usually necessary to rotate the antenna whenever the channel is changed.



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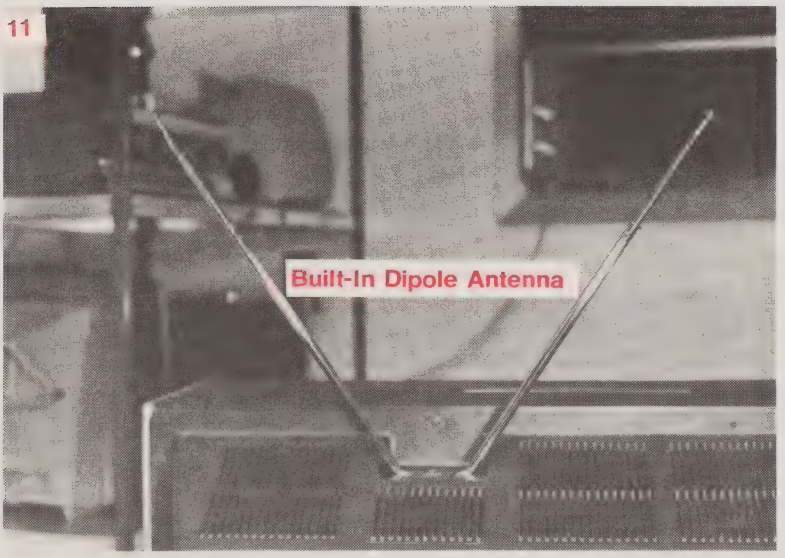

An indoor antenna usually requires some adjustment each time the channel is changed. If it is the type shown in Fig. 13, either the antenna must be turned in a different direction for each channel or the switch rotated to the position that provides the best reception. If the antenna is the built-in type shown in Fig. 11, it is often necessary to adjust each rod for the best reception. Another disadvantage of the indoor antenna is that reception is often affected by persons moving about the room. It is not unusual to adjust this type of antenna for the best reception and then have the color disappear when you walk away from the set. However, in many cases, you can find a compromise adjustment that will provide satisfactory reception on most channels in the area.

One of the most frequent problems with antennas is a loose or disconnected antenna wire. Fig. 14 shows a typical situation where one of the conductors has come loose leaving one side of the antenna lead disconnected. In an outdoor installation, this same problem often occurs at the antenna as the result of wind. This type of problem can be reduced by using the crimp-on terminals shown in Fig. 15. The antenna lead should also be supported by stand off insulators on the antenna mast. (See Fig. 13.)

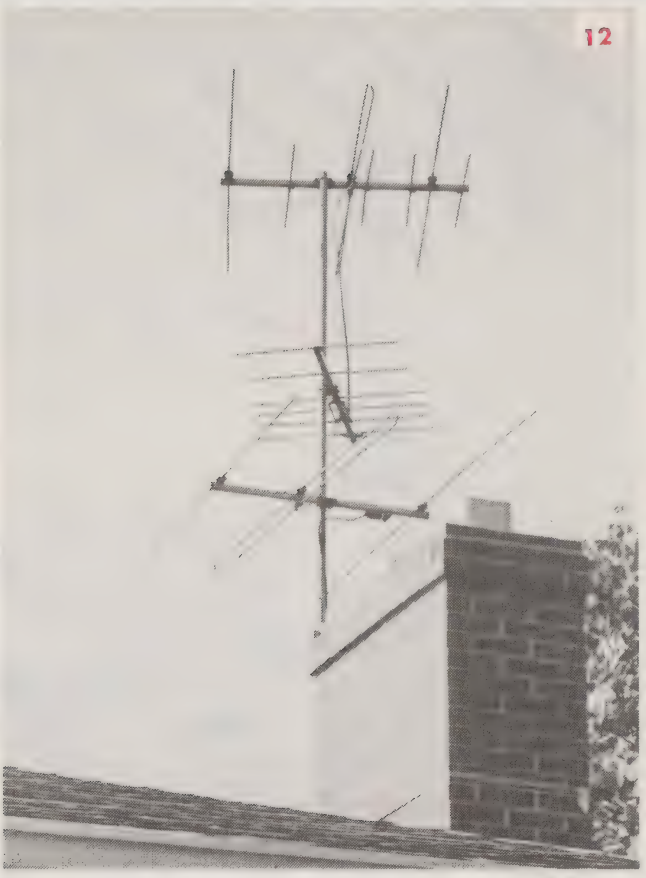

Fig. 16 shows the different types of antenna lead commonly used. The first four types are basically the same—parallel line or twin lead. The antenna lead shown at the bottom of the illustration is known as coaxial cable. The type of lead suited to a given installation depends on several factors. Generally, the shielded parallel line is considered to have the best overall characteristics. However, it is the most expensive and is somewhat more difficult to work with. Coaxial cable has become increasingly popular in modern antenna installations. The disadvantages of coaxial cable include higher signal loss and the requirement of matching trans-

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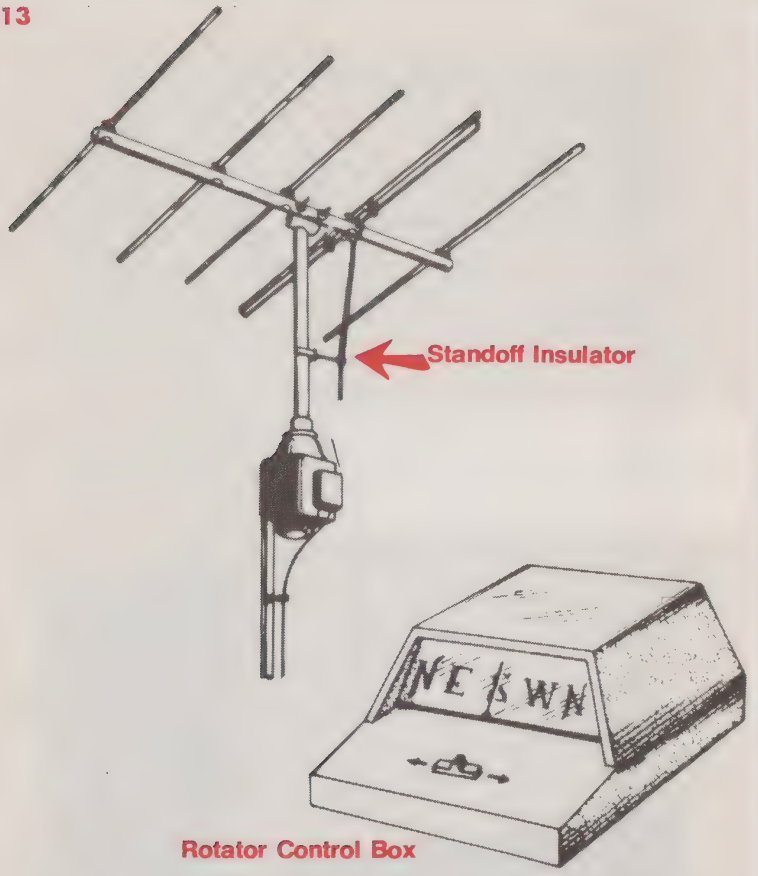
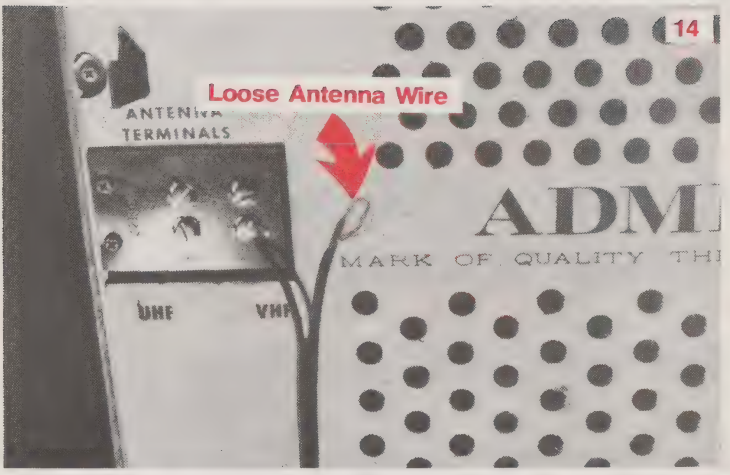


formers at both the antenna and the television receiver. Many antennas are equipped with a matching transformer and the proper fitting for connecting coaxial cable.

A typical coaxial-cable installation at the receiver is shown in Fig. 17. The coaxial cable is connected to a matching transformer which, in turn, is connected to the antenna terminals of the receiver. Some television receivers have antenna terminals for both parallel line and coaxial cable. When coaxial cable is used, the proper fitting must be installed on the cable. The coaxial fitting used for television antenna installations is the F-659 type connector. Before installing the connector, the cable should be prepared as shown in Fig.



18. When the connector is installed properly, the center conductor should protrude just beyond the open end of the connector. The collar at the rear of the connector is then crimped to secure the connector to the cable. Although a special crimping tool is made for this purpose, the connector can be crimped with a pair of pliers as shown in Fig. 19. First, pinch one side of the collar with the nose of the plier, and then pinch the other side so that the connector is firmly crimped around the outer jacket of the cable. In most cases, the crimping collar is an integral part of the connector. However, some connectors use a separate crimping ring to secure the connector to the cable. By replacing the ring, it is possible to use the connector again.

As shown in Fig. 20, most television receivers have a separate set of terminals for the vhf and uhf antennas. Some set owners inadvertently connect the vhf antenna to the uhf ter-

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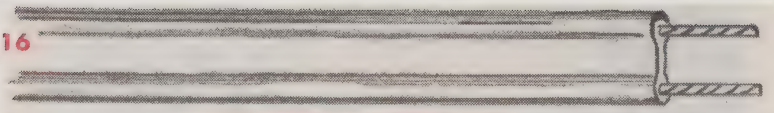
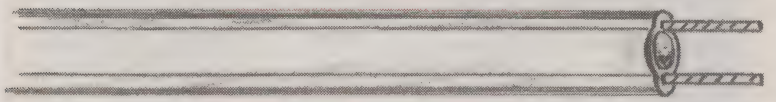
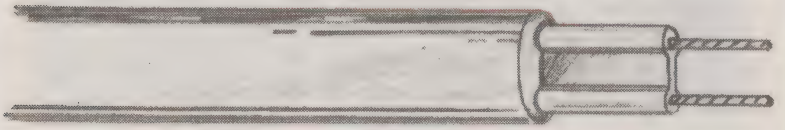


(A) Flat-Ribbon Parallel Line



(B) Tubular Parallel Line

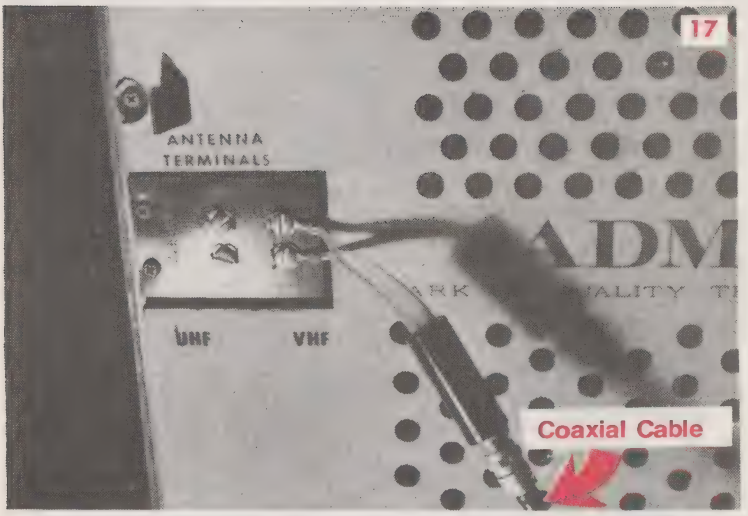


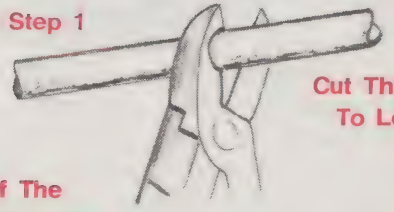
(C) Encapsulated Parallel Line (Unshielded)

(D) Encapsulated Parallel Line (Shielded)

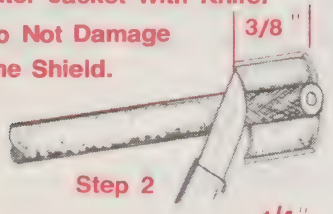
(E) Coaxial Cable

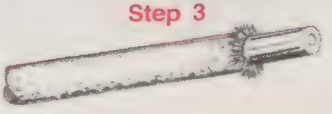
minals. The result is usually a snowy picture on the vhf channels which no amount of antenna adjustment will cure. If the markings are obscured on the terminals of your set, connect the vhf antenna to the set of terminals that provides the best reception. The same type of problem often occurs with indoor antennas that have separate leads for vhf and uhf. If the leads are not marked, first connect them one way and then the other to determine which lead is for vhf and which is for uhf. Mark the leads so that you will know which is which in case they have to be disconnected later.



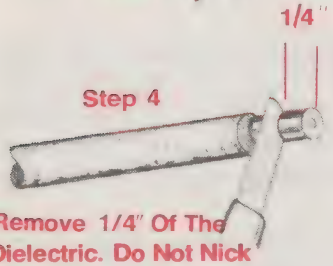


Remove 3/8" Of The Outer Jacket With Knife. Do Not Damage The Shield.

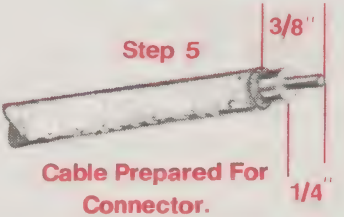




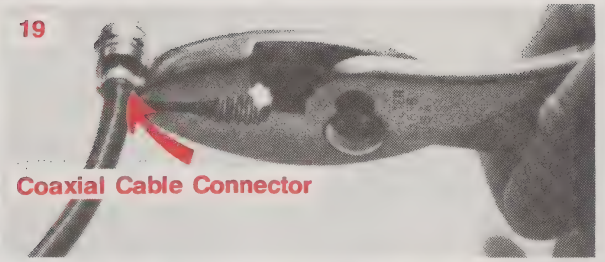
Fan The Shield Braid (And Foil) Over The Outer Jacket; Trim Close To Jacket.

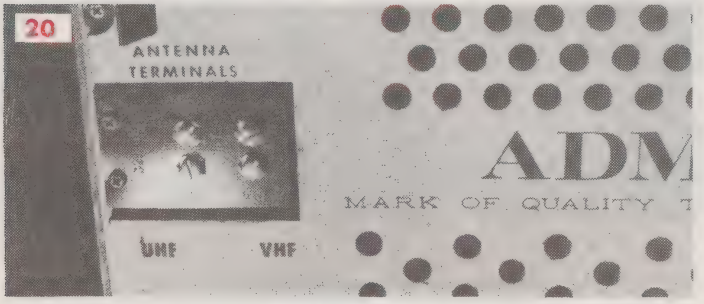


Remove 1/4" Of The Dielectric. Do Not Nick Center Conductor.



Cable Prepared For Connector.



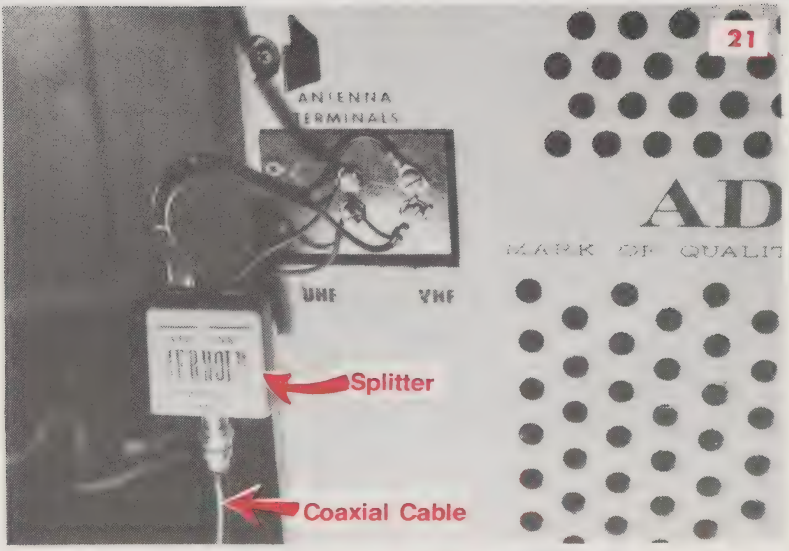


If the same antenna lead is to be used for both vhf and uhf, it will be necessary to use a *splitter* such as shown in Fig. 21. The antenna lead is connected to the splitter terminals and the vhf and uhf leads from the splitter are connected to their respective terminals on the television receiver. Splitters are available for antenna installations using either twin-lead type antenna lead or coaxial cable. The splitter shown in Fig. 21 is for coaxial cable.

DIRTY TUNER CONTACTS

Dirty tuner contacts are a common problem with many television receivers. The usual symptom of dirty contacts is the inability to tune in one or more channels without holding the channel selector knob in a certain position. Often, it is necessary to reset the channel selector several times while viewing a single program.

Dirty tuner contacts can often be cleaned by proper application of a suitable tuner cleaner. Cleaning a television tuner is a project that requires a reasonable amount of care. The



first consideration is the selection of a proper tuner cleaner. Although there are several types of tuner cleaning products on the market, the most suitable tuner cleaner for general use is the type that contains both a solvent and a lubricant. Avoid the foam-type cleaners. These require careful application and should be used only by the professional television technician. Choose a good quality tuner cleaner that will not harm plastics or detune the tuner. This should be stated on the label. Most tuner cleaners come in an aerosol can with a plastic extension tube as shown in Fig. 22.

Some tuners are much more accessible than others. In some cases, it is necessary to remove the tuner itself or even the complete chassis to gain access to the tuner. In this case, the job should definitely be left to the professional. Fig. 23 shows an example of a tuner which can be serviced rather easily by removing the rear cover from the set. When cleaning the tuner, it is very important to apply the cleaner only to the tuner contacts. Excessive cleaner on some of the capacitors and other components can lead to trouble. To do the job properly, the tuner cover should be removed.

There are two types of tuners in general use—the switch-type and the turret-type. The switch-type tuner, shown in

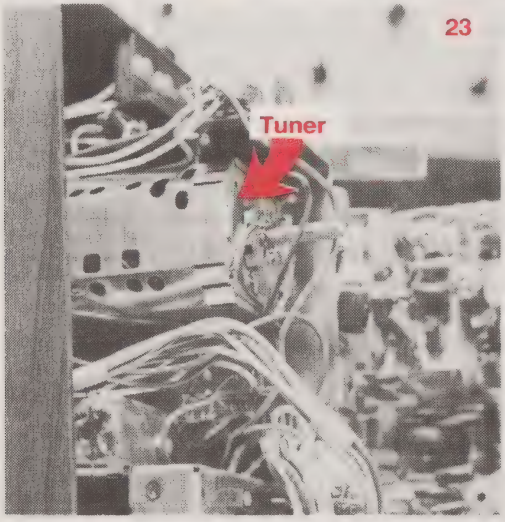
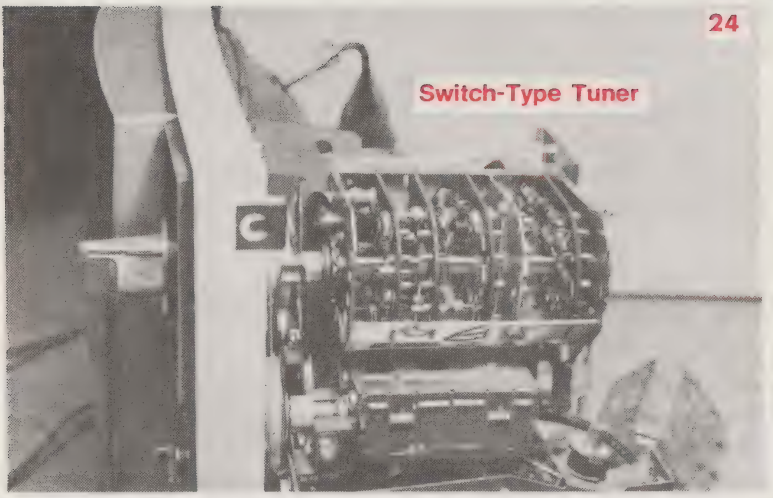
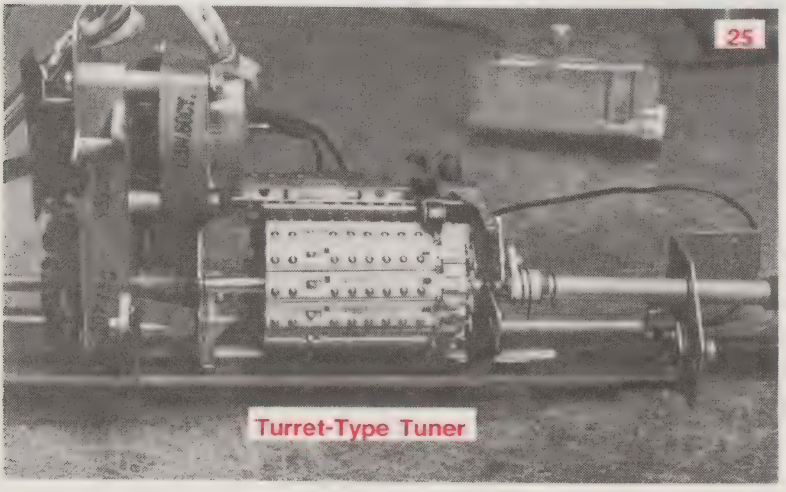


Fig. 24 uses rotary wafer switches to select the various tuned circuits within the tuner. To clean this type of tuner, apply the cleaner to the individual switch sections and then rotate the channel selector through all the channels several times. In some cases, a second application of cleaner may be necessary.



A turret-type tuner is shown in Fig. 25. In this type of tuner, the tuning components for each channel are mounted on individual strips. These strips, in turn, are mounted on a turret drum. When a given channel is selected, the contacts on its respective strip touch a set of fixed spring contacts. To clean the turret-type tuner, spray the cleaner on the contacts and then wipe the contacts with a soft, lintless cloth. After wiping the contacts, spray them again with the cleaner to lubricate them. Make sure that the cleaner you are using contains a

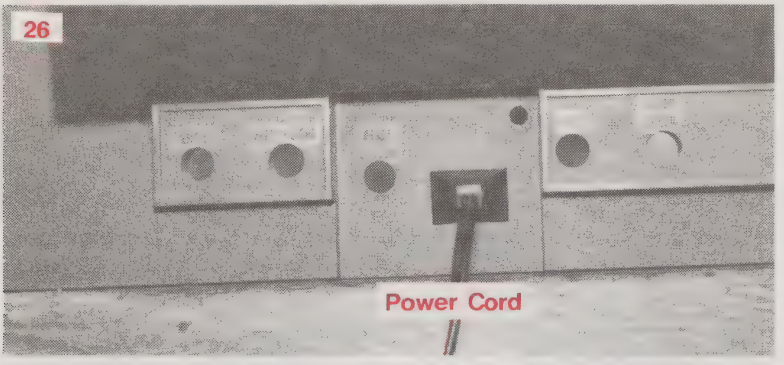


lubricant. If the contacts are not properly lubricated, they can be quickly damaged.

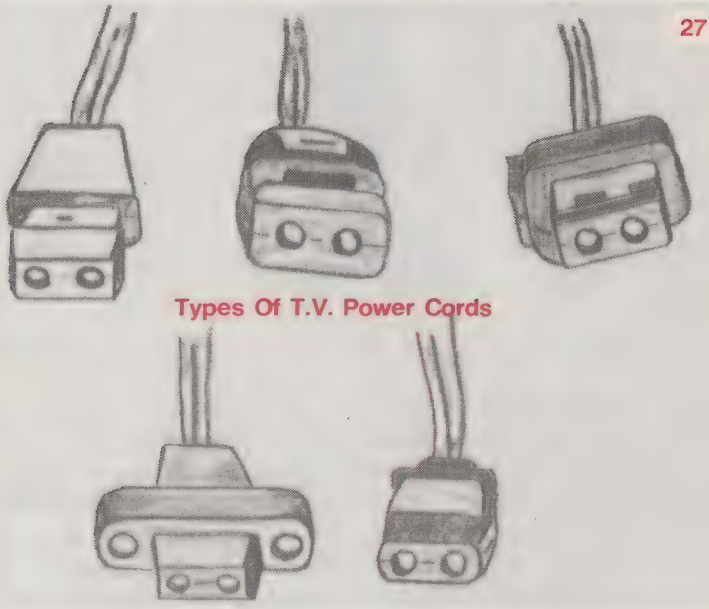
If the tuner operation is still erratic after cleaning, the contacts may be worn or the spring contacts may be bent. In this case, a service technician will have to remove the tuner for repair. Most television technicians send such tuners to firms that specialize in rebuilding tuners.

REPLACING POWER CORDS

If your set intermittently goes dead, the trouble may be due to a defective power cord. This is especially true for portable television receivers that are often moved from place to place. The continued flexing of the power cord causes one of the conductors to break and then make intermittent contact. This usually occurs at the point the power cord enters the back of the set (see Fig. 26). If the receiver operates intermittently when the cord is flexed at this point, the cord is probably defective. This condition will eventually lead to arcing and may cause a fire.



When replacing the power cord on a television receiver, you should use only the original type. If a substitute cord is used, it may not be mechanically secure and will not make proper contact. Several types of tv power cords are shown in Fig. 27. The proper cord can usually be ordered from the dealer. Most power cords are held in place by a metal clip inside the back of the receiver. This clip can be removed



with a screwdriver as shown in Fig. 28. Remove the old cord from the back and install the new one in its place using the original clip.

Many television receivers use a *polarized* power cord. The female end of a polarized cord is shown in Fig. 29. Notice that one of the contacts is larger than the other. When replacing a polarized power cord, make sure that you install

29

Polarized Power Cord

it so that the large contact on the female end of the cord mates with the large contact on the chassis.

If the power cord is defective at the plug, you can cut off the defective portion of the cord and replace the plug. When replacing the plug, you should avoid using the "snap-on" type. This type of plug often makes poor contact with the conductor. The result is either an intermittent connection or a high-resistance connection that overheats. Use the conventional replacement plugs with the screw-type terminals. Better yet, replace the entire power cord.

REPLACING CHANNEL INDICATOR LAMPS

When the channel indicator light goes out, it would seem that replacing the lamp should be a simple matter. Unfortunately, this is usually not the case. On some television receivers, the small lamp that illuminates the channel numbers can be replaced by removing the channel selector knob. However, most of the time, it is necessary to replace the bulb from inside the cabinet. In some instances, the complete tuner assembly must be removed to replace the bulb.

If the channel indicator lamp goes out on your set, remove the channel-selector knob and the fine-tuning knob to see if the bulb can be replaced from the outside. If not, replace the knobs and remove the back from the set. Using a flashlight, check around the tuner area to see if you can locate

the lamp. If you cannot find the lamp, the tuner assembly will probably have to be removed. This is a job for the television serviceman. Since it is rather expensive to pay for a service call just to replace a bulb, you may want to wait until you need a serviceman for additional repairs. If you are able to replace the lamp, make sure that you use the same type number as the original. Some commonly used channel indicator lamps are shown in Fig. 30.

PICTURE-TUBE BOOSTERS

A weak picture tube is usually the result of reduced emmission of electrons from the cathode. The cathode emits electrons as a result of being heated by the filament or heater. By increasing the voltage applied to the filament, the cathode becomes hotter and the electron emission usually increases. This is the principle of the picture-tube booster. It is simply a transformer that increases the filament voltage. A typical booster is shown in Fig. 31.

The installation of a picture-tube booster is only a temporary solution to a weak picture tube. The performance of the picture tube may improve for a few weeks or even several months, but eventually it will have to be replaced. In some cases, the additional voltage applied to the filament will cause it to burn out in a short time. Therefore, you should not consider using a booster until you are sure the picture tube is weak. There are other defects which can cause the same symptoms as a weak picture tube, so it should be checked by a qualified technician. If the tube checks weak, but the set is in fairly good condition, and receives frequent

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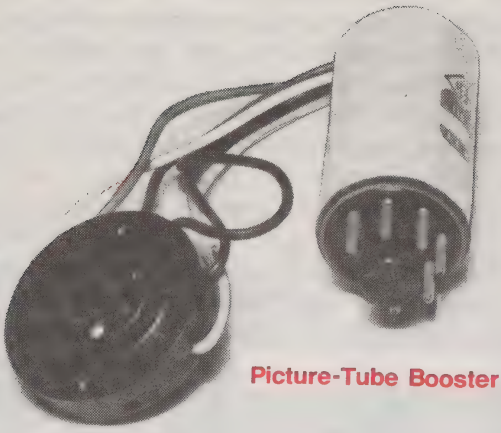

Picture-Tube Booster

use, it would be wise to consider a new tube. However, if the set is an old model and is used only occasionally, installing a booster may be the best procedure.

There are two basic types of boosters. One type is for sets with the tube filaments wired in parallel and the other type is for sets with series filaments. Also when purchasing a booster (sometimes called a brightener), make sure that it has the same type of sockets as the picture tube.

REPLACING CIRCUIT MODULES

Since the introduction of the "works in a drawer" by Motorola a few years ago, many television manufacturers have developed solid-state sets with plug-in circuit modules. A typical solid-state television receiver employing plug-in modules is shown in Fig. 32. The modules in this set are actually printed-circuit boards that are plugged into the chassis edgewise. Fig. 33 shows one of the modules removed from the set. In some sets, the modules have female connectors along their edges and the module is installed on stud-type terminals so that it is parallel to the chassis.

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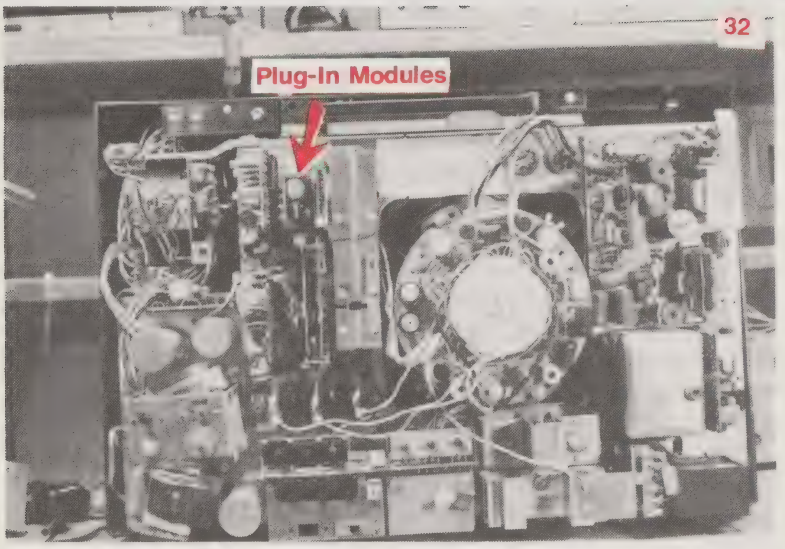


33

Module Removed From Television Set

Some people have the notion that this construction technique was developed so that the set owner could make his own repairs. This is just not the case. Defects in solid-state receivers are generally more difficult to repair than in tube-type receivers. It is usually necessary to take the set to the shop in order to troubleshoot solid-state circuitry. Television manufacturers learned from the computer industry that it

was less expensive to replace a circuit module in the field than it was to troubleshoot and repair conventional solid-state circuitry in the shop. Also, replacement of an entire circuit module usually results in more-reliable repairs.

There are several reasons why the average set owner should *not* attempt to replace circuit modules in his own set. Most television manufacturers have developed specialized servicing techniques for their module-type receivers. These techniques often require voltage measurements or other test procedures before modules are substituted. This enables the technician to locate other defects which may have caused the original module to fail. If a new module were installed without repairing a defect that caused the original module failure, the new module could also fail. Also, when replacing a circuit module, it is often necessary for the technician to make critical adjustments to the receiver. In some cases, the set may not operate properly if these adjustments are not made.

Sometimes it is necessary to substitute two or more modules before a defective module is located. Since there is usually no practical way of testing circuit modules in the field, the set owner would have to purchase several replacement modules in order to troubleshoot his own set. Even for the television technician who services these sets day in and day out, it is expensive to stock a complete set of circuit modules for a particular set. For the set owner to do so would be economically impractical. If you are having trouble with your solid-state television set, and it cannot be corrected by normal adjustments, it is time to call your television service technician.

SECTION 4

Checking and Replacing Tubes

Most early television receivers had many more tubes than modern tube-type sets. Therefore, a majority of the defects which occurred in those early receivers were due to faulty tubes. When the television ceased to function properly, many set owners began to remove their own tubes and take them to the neighborhood radio and tv shop to be tested. Eventually, do-it-yourself tube testers began to appear in almost every drugstore and people were testing their own tubes. For some set owners, this procedure worked very well. For others, it ended in minor disaster because of tubes being placed in the wrong sockets, accidently broken picture tubes, and so on.

As television engineering and design progressed, fewer tubes were used. Although these newer sets generally developed less troubles, a greater percentage of the problems that occurred were due to defects other than faulty tubes. Set owners who had been testing and replacing their own tubes found that more of the problems occurring in their television receivers were due to circuit defects. As a result, most people now depend on the professional television technician to service their television receivers.

Do-it-yourself tube testers (Fig. 1) can be found in almost every large drugstore, many discount stores, and even in some hardware stores. There are still people who, when the tv set fails, pull out all of the tubes and head for the drugstore. If you are one of these people, or if you are thinking

about joining them, there are some factors which you should consider.

It is not uncommon for a set owner to take all of the tubes out of his set, test them, and buy five or six new tubes, only to find that he still has the original problem or even an additional problem. This could be due to a faulty tube tester or the inability of the person testing the tubes to interpret the results of such tests. It is also possible for six tubes to test bad and still not be the cause of a particular failure. A tube tester may indicate that a tube has a short or grid leakage, and yet the tube will still give marginal performance when installed in a television receiver. This marginal performance may not be readily apparent to some viewers, although an outright failure would be. Of course, the defective tubes should be replaced even though the set might operate with them installed.

The do-it-yourself type tube tester is limited in its ability to totally evaluate the condition of a particular tube. In fact, there are some tubes which will test good and still not operate in television receivers. The experienced television technician can usually tell from the symptoms which tubes may be causing a particular trouble. However, there are tubes that he will routinely test for marginal operation due

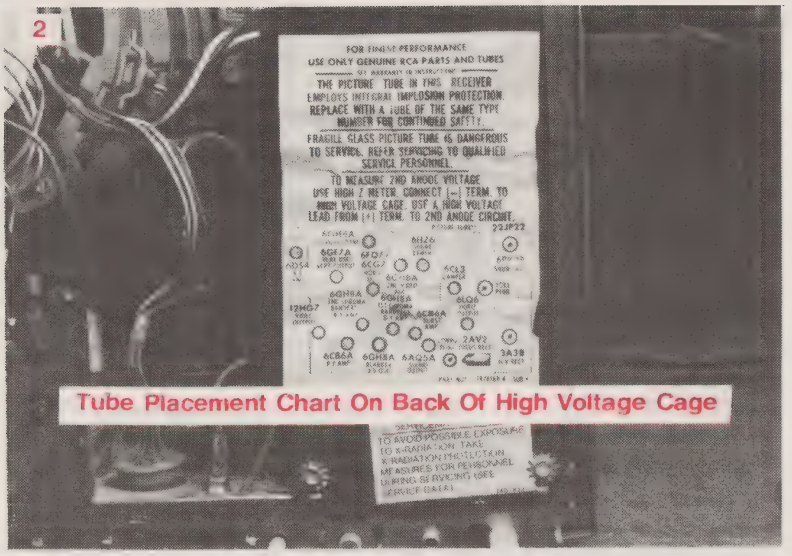
to shorts, leakage, or weak emission. These tubes include those in the tuner, video i-f section, sync section, sound i-f section, and the color section.

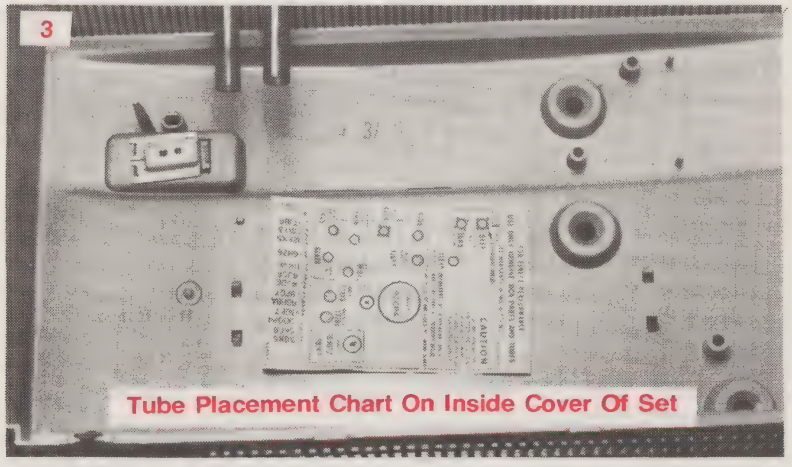
It is not recommended that the set owner pull out all of these tubes and test them in an effort to improve the overall operation of his set. There is a good chance that you will end up replacing tubes that were good and missing some of the bad ones. This may be due, in part, to the unreliability of the tube tester itself. Also, by removing several tubes at a time, there is a possibility that you may get some of them back into the wrong sockets. This often leads to damaged circuit components such as resistors.

However, if you are having a particular trouble and think it may be caused by a defective tube, you may want to check one or two tubes. In order to do this, you should be able to relate a given symptom to the tube or tubes that could cause the trouble. For instance, if the picture will not hold either vertically or horizontally, you know that there is a sync problem and you should check the sync tube or tubes. Of course, the trouble may be due to a defect other than a bad tube. We will discuss some of the basic trouble symptoms and identify the tube or tubes that may be causing the problem.

Before attempting to test or replace any tubes, read *Safety Considerations* in Chapter 3. Be especially careful *not* to remove or replace any tube with the power applied to the set. Carefully inspect each tube when you remove it to see if the type number is clearly legible. If not, use a piece of masking tape to label the tube. You should be able to identify the tube from the *tube placement chart*. Fig. 2 shows a tube placement chart on the back of the high-voltage cage, while Fig. 3 shows a chart inside the rear cover of a set. When the tube is replaced, be sure to remove the tape so that it will not burn.

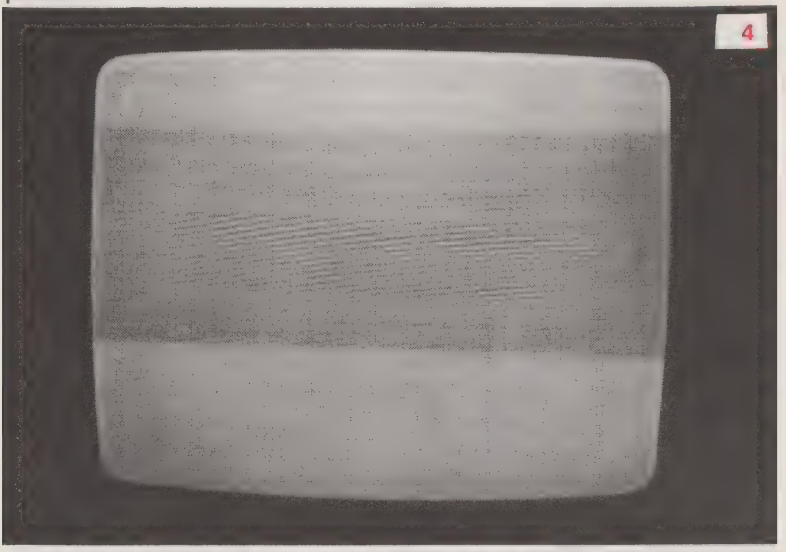
If the tube checks bad, replace it with only the same type number. Do not accept substitutes unless the tube has been superseded by a newer type. Substitutes do not work satisfactorily in some television circuits. Of course, the replacement tube does not have to be the same brand as the original.


2
FOR FINEST PERFORMANCE
USE ONLY GENUINE RCA PARTS AND TUBES
THE PICTURE TUBE IN THIS RECEIVER
EMPLOYS INTEGRAL IMPLOSION PROTECTION.
REPLACE WITH A TUBE OF THE SAME TYPE
NUMBER FOR CONTINUED SAFETY.
FRAGILE GLASS PICTURE TUBE IS DANGEROUS
TO SERVICE. REFER SERVICING TO QUALIFIED
SERVICE PERSONNEL.
TO MEASURE 2ND ANODE VOLTAGE
USE HIGH Z METER. CONNECT (–) TERM. TO
HIGH VOLTAGE CAGE. USE A HIGH VOLTAGE
LEAD FROM (+) TERM. TO 2ND ANODE CIRCUIT.
Tube Placement Chart On Back Of High Voltage Cage



When a tube is replaced, it is sometimes necessary to make adjustments to the circuit in which the tube is used. When such a tube is listed as a possible cause for the trouble symptoms given in the remainder of this chapter, we will note the required adjustments. Some of these adjustments must be performed by a qualified television technician. In this case, we will recommend that you leave the job to the service technician.

One of the symptoms we will discuss is *no raster.* The raster is the illuminated area produced on the face of the picture tube when it is scanned by the electron beam. In other words, whenever the screen of a television receiver is illuminated, whether there is a picture or not, it is said to have a raster. Fig. 4 is an example of a raster without a picture. Of course, if you do not have a raster, you cannot have a picture.



The following are some of the general trouble symptoms that may be caused by defective tubes in a television receiver. There are many other symptoms which may be unique to a particular receiver or too complex for the scope of this book. While the tube replacement information is included in this book to aid those who wish to test and replace their own tubes, we do not generally recommend such procedures for those inexperienced in electronic troubleshooting.

No Picture, No Raster, Has Sound

This symptom can be caused by a loss of high voltage to the picture tube, improper bias voltages on the picture tube, or a defective picture tube. Tubes that can cause loss of high voltage are:

High-Voltage Rectifier
Horizontal Output Tube
Damper Tube
Horizontal Oscillator Tube (Replacement of this tube may require adjustment of the horizontal hold control. In some sets, it is also necessary to adjust the horizontal oscillator coil if the range of the hold control is limited. Such an adjustment should be performed by a qualified technician.)
High-Voltage Regulator Tube (Color set only.)

Improper bias voltages on the picture tube can be caused by a defective tube in the video section of a color receiver. If you have no raster on a color set, and you think you have high voltage, suspect the following tubes:

Video Amplifier Tube
Video Output Tube

No Picture, No Raster, No Sound

This symptom is usually caused by a defect in the power supply which results in the loss of power to all sections of the receiver. If the tube filaments are connected in series, any tube with an open filament would cause the set to go dead. In this case, none of the tubes will be lit. Some television receivers are designed so that the sound will go out if there is a loss of high voltage due to a failure in the horizontal-sweep section. In these sets, a defective tube that causes the loss of high voltage may also cause the sound to be dead.

No Picture or Sound, Has Raster

Check the following tubes:
Tuner Mixer/Oscillator Tube
Video IF Amplifier Tubes
Video Amplifier Tube (Black-and-white receivers only.)

No Sound, Has Picture and Raster

Check the following sound tubes:
Sound I-F Amplifier Tube
Sound Detector Tube (May be called Quadrature or Ratio Detector.)

Audio Amplifier Tube
Audio Output Tube

Snow in Picture

See Fig. 5. This symptom is often caused by a faulty antenna or antenna lead. Snow may also be caused by a defect in the tuner. Check the following tuner tubes:

RF Amplifier Tube
Mixer/Oscillator Tube

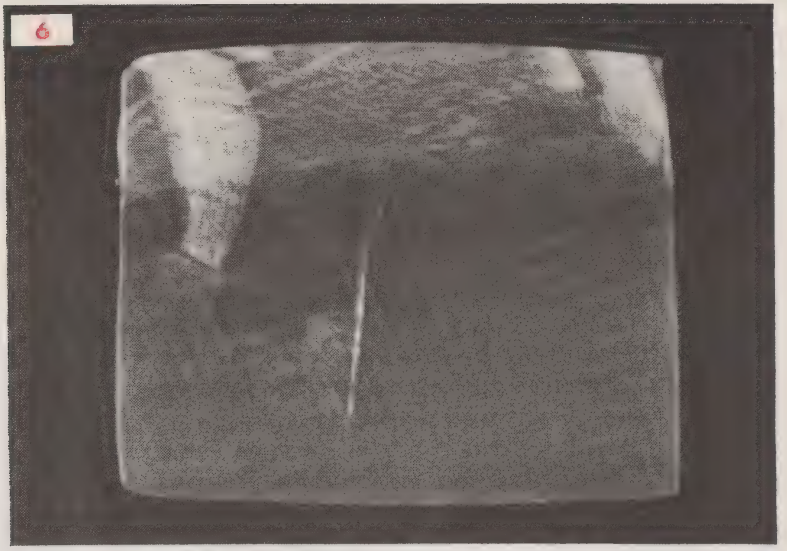
Picture Overloads

This symptom is shown in Fig. 6. It is usually characterized by bending and distortion of the picture. There may also be a buzz in the sound. Strong channels may blank out completely, while very weak channels may appear normal. Check the following tubes:

AGC Keyer
AGC Amplifier

Loss of Sync

This symptom is shown in Fig. 7 and is characterized by the inability to hold the picture either horizontally or vertically. Loss of sync may be caused by the following tubes:



Sync Separator
Sync Amplifier

Many modern tube-type television receivers use only a sync separator tube.

Picture Rolls

If adjustment of the vertical hold controls fails to stop the rolling, there is probably a defect in the vertical-sweep circuit. Although this trouble is often caused by defective components other than tubes, check the following tubes:

Vertical Output Tube

Vertical Oscillator or Multivibrator Tube

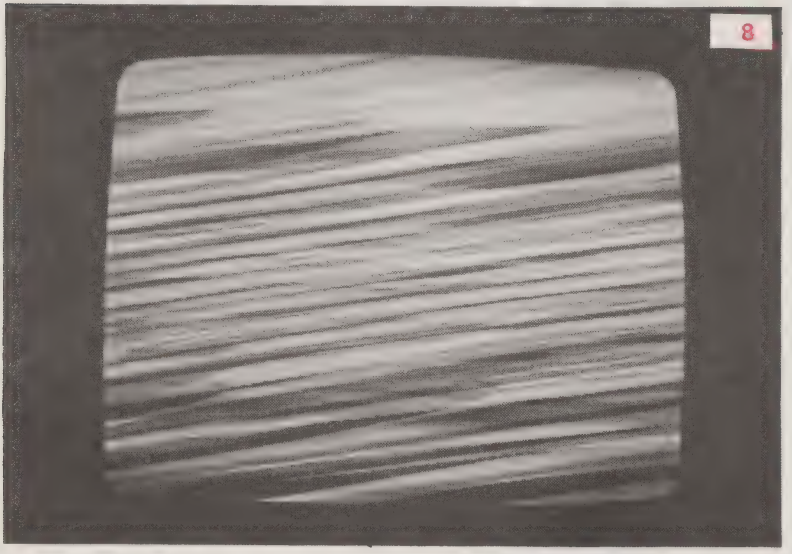
In most modern receivers, these two functions are combined in a single dual-section tube.

No Horizontal Sync

This trouble symptom is shown in Fig. 8. If a normal picture cannot be restored with the horizontal hold control, the following tubes may be defective:

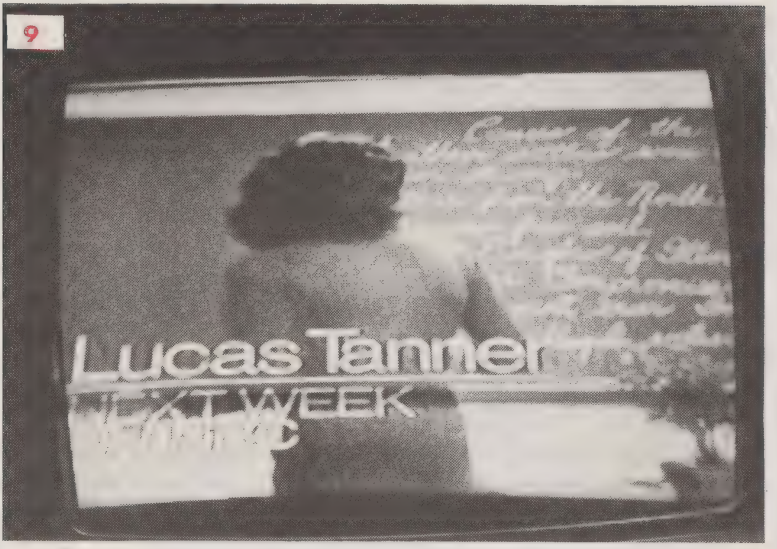
Horizontal AFC Tube (Most modern sets use solid-state diodes for this function.)

Horizontal Oscillator Tube (It may be necessary to adjust the horizontal hold control and the horizontal oscillator coil when replacing this tube. Refer adjustment of the oscillator coil to a qualified service technician.)



This symptom is shown in Fig. 9. Check the following tubes in the vertical sweep section:

Vertical Oscillator or Multivibrator Tube
Vertical Output Tube



Picture Narrow

Fig. 10 shows a picture that is pulled in on both sides. This symptom is often caused by a defective tube in the horizontal sweep section. Check the following tubes:

Horizontal Output Tube
Damper Tube

This is a tube defect that is often missed by a tube tester. These tubes may check good and still not be able to provide full sweep under load. The best test here is to replace the original tube with a known good tube.

No Color

If this symptom appears only on one channel and the color is normal on the other channels, the fine tuning control or the antenna may need adjusting. If there is no color on any channel, check the following tubes:

Chroma Bandpass Amplifier Tube
Burst Amplifier Tube
Chroma Oscillator or 3.58-MHz Oscillator Tube (When this tube is replaced, it is sometimes necessary to readjust

the chroma oscillator circuit. Refer this adjustment to a qualified television technician.)

No Color Sync

This trouble symptom is characterized by the color portion of the picture breaking up into multicolored bars. Loss of color sync may be caused by one of the following tubes in the color section:

Burst Amplifier Tube

Chroma Oscillator Tube (Replacement of this tube may require adjustment of the chroma oscillator circuit. Refer this adjustment to a qualified television service technician.)

Missing Colors, Black-and-White Normal

Check the following tubes in the color section:

Chroma Demodulator Tubes

Most tube-type color television receivers have two demodulator tubes, although some sets may have three. In some receivers, the demodulators are incorporated into a single multisection tube.

The trouble symptoms described in this chapter represent the more common symptoms that occur in a television re-

ceiver. There are, of course, many other trouble symptoms which are outside the scope of this book. It is important to note that not all of the tubes which are suggested as a possible cause of a particular symptom may be found in every set. Also many late model television receivers employ tubes in some circuits and transistors or other solid-state devices in other circuits. Such sets are known as *hybrid* receivers. Do not attempt to replace the transistor counterpart of a tube suggested here. Servicing of solid-state circuits in a television receiver should be left to the professionals.

SECTION 5

Television Service

Although the information in this book should enable you to make minor repairs and adjustments to your set, you will still need to call a television serviceman from time to time. When the time comes, it is important to be able to call someone who you feel is both competent and reliable. If you have a television serviceman who is dependable and you have been satisfied with his service in the past, then this is the person you should call. However, for one reason or another, some people call a different television repair shop every time they need service. This practice usually results in mediocre service at a higher cost.

If you do not have a regular television serviceman or you have recently moved to a new area, it would be wise to locate a qualified technician that you can call when you need service. In a metropolitan area, you can usually find several television repair shops listed in the yellow pages of the phone book. Of course, you cannot judge the quality of a service shop by their listing in the phone book. One of the best ways to find a good service shop is to talk to your neighbors or friends who live in the same area. If a certain shop or technician is recommended by several people, the chances are pretty good that you would also receive good service from that shop.

You may have the names of two or three shops that interest you. Before you actually need service, you might visit a shop and talk to the owner or technician. Tell him the make

of your television set and ask if they would service it when needed. Some shops now limit their service to two or three brands. At the same time, look around the shop. Is it clean and businesslike? Are the personnel friendly and courteous? The appearance of the shop and the attitude of its personnel should give you some idea of the type of service to expect. Remember, however, that a good repair shop may be fairly cluttered, especially during a busy season.

While the majority of television repair shops are small one- or two-man operations, service organizations employing several technicians can be found in most large metropolitan areas. The larger service organizations generally offer a wider variety of services than a small shop. However, they rarely give the personal type of service that is characteristic of most self-employed television service technicians. If you live in a small community, your choice of a television service shop is probably very limited.

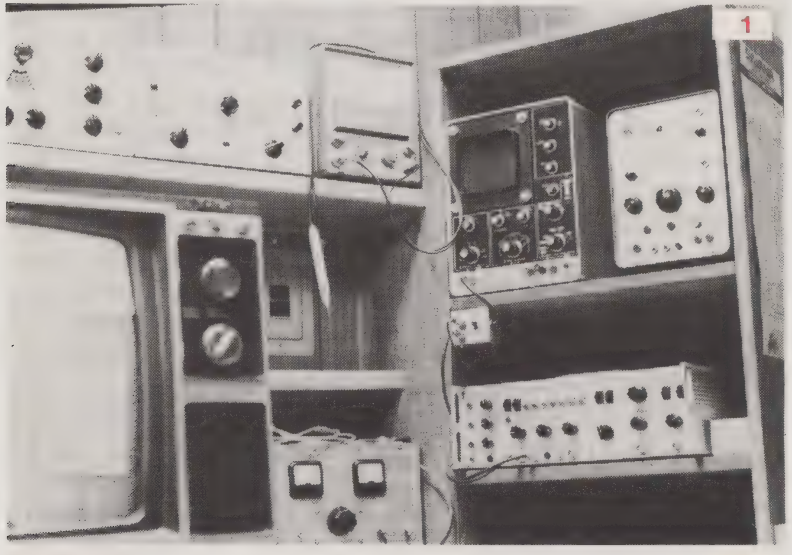
A modern color television receiver is a sophisticated piece of electronic equipment that represents a rather sizable investment for most people. Therefore, you want some assurance that the serviceman who shows up to repair your set is competent to do the job. In the early days of television, there were quite a few television repairmen with questionable qualifications. It was not unusual for someone with limited electronics experience to buy a tube tester and a few tubes and announce that they were in the television repair business. Since tubes were the major source of trouble in early television receivers, some of these people had limited success. With the advent of color television, most of these so-called "tube pullers" could not cope with the service problems occurring in the more complex color receivers. Today, the wide-spread use of transistors and other solid-state devices has limited the television service business to the professional electronics technician.

Several states and local governments now require the licensing of television technicians. In most cases, the applicant for a license is required to pass a comprehensive examination to prove his competency. In addition, the applicant must usually have a prescribed amount of education and experience in television servicing.

SERVICE CHARGES

If you are shopping for television service, it is readily apparent that service charges vary considerably. One of the major reasons for this difference is the various methods of charging for service work. For instance, the price quoted for a service call by one shop may be the charge for just coming to your home and not include any actual service to your set. In this case, you may be charged an hourly labor rate for the repair work or a flat fee for each repair operation. The hourly rate seems to be the more popular method of charging for the repair work. Other shops may quote a somewhat higher price for a service call which includes up to one-half hour of labor. Any additional labor is then charged at an hourly rate.

There are many television service operations that cannot be practically performed in the customer's home. Such operations often require the use of specialized test equipment (Fig. 5-1) in the shop. If it is necessary to take your set or chassis to the shop, there are additional service charges. Again, there are different ways you may be charged for this service. A common method is to charge separately



for the service call, pick up and delivery, and the shop service. The shop service may be charged at an hourly rate or a flat fee for the particular service required. Some shops charge for the service call and then lump all additional charges into a *labor* charge.

Since service charges vary from one area to another, we will not attempt to quote any prices for television service. Regardless of the method used to charge for service, the service charges established by any successful shop must be based on the cost of doing business. For this reason, there will be some variation in service charges from one shop to another. The fact that one shop may seem to charge a little more than another, does not necessarily mean that one is better than the other. There may be a number of valid reasons for such price discrepancies. Therefore, do not allow yourself to be overly influenced by price when shopping for television service. Of course, if someone's service charges seem to be way out of line, it may be wise to try another shop the next time.

Many people misunderstand the basic economics of reliable television service. For some reason, they believe that the cost of repairs should be related to the actual value of the unit being serviced. Of course, this is a fallacy. The time that it takes to adequately service an older black-and-white television receiver may often be greater than the time required to service a late-model color set. Also, the cost of the parts may run considerably higher. Therefore, it is not fair to expect the technician to base his service charges on the value of your set. On the other hand, if the technician estimates that it will cost more to repair a set than it is worth, he has an obligation to so inform the customer. It is then up to the set owner to decide if he or she wants the set repaired.

When compared to the cost of a new television receiver, service costs may seem high to some people. However, the fact remains that a television receiver is a complex piece of electronic equipment. The price of a new television set is relatively low due to the economics of mass production and mass marketing. A piece of industrial electronic equipment with the complexity of a television receiver will usually cost

several times the price of the television receiver. This is due, of course, to the very limited demand for a particular industrial unit.

When service is required for any type of electronic equipment, it usually must be performed on an individual basis. Since so many different failures can occur in electronic equipment, each service problem is unique and often requires the attention of a trained electronics technician. With industry competing for the limited number of competent technicians, it is not surprising that there is a shortage of qualified technicians in the television service field. As a result, qualified television technicians are beginning to charge for their services on a more professional basis. As any professional, the television service technician must continue his education to keep up with the technology of his field. When compared to the cost of most other services, television service charges are quite reasonable.

WARRANTIES AND GUARANTEES

When you purchase a new television set, the manufacturer usually provides a warranty that guarantees the set for a given length of time. In the early days of television, the picture tube was usually guaranteed for one year and all other parts for 90 days. The purchaser was required to pay for any labor during the warranty period unless it was provided by the dealer. Many dealers agreed to service the set for the first 90 days free of charge.

In the early 1960's, some manufacturers began to offer one-year free service on certain models as a sales inducement. In addition, the picture tube and other components were warranted for extended periods. At the present time, most television manufacturers guarantee the parts and labor for one year. However, some lower-priced portables may be guaranteed for only 90 days. Also, some manufacturers have extended their parts and service warranties on certain solid-state models to two years and more.

Most manufacturers depend on independent service dealers to handle their warranty work. If your set fails within

the warranty period, you should contact the dealer who sold it to you. Many dealers are also in the service business. In this case, the dealer will usually provide warranty service directly. If the dealer does not have a service department, he will refer you to a service dealer who has a warranty contract for your make of set. To avoid any misunderstandings, make SURE THAT YOUR SET IS IN WARRANTY. To be sure, read the warranty furnished by the manufacturer. Since some manufacturers guarantee their various models for different lengths of time, there has been some confusion about warranty periods. For example, the salesman who sold you the set may have mentioned that a certain model was guaranteed for two years but neglected to tell you that the model you purchased was only guaranteed for one year. Naturally, unless you read your warranty, you would probably believe that your set was guaranteed for two years.

When you contact the service dealer for warranty work, be sure to tell him that your set is in warranty. He will probably ask for the model number and the date the set was purchased. If the service dealer tells you that your set is out of warranty, check the manufacturer's warranty again. If there is a disagreement, contact the dealer that you purchased the set from. Also, make sure that you have mailed your warranty registration card. Some manufacturers will not honor a warranty labor claim if the registration card has not been mailed. In this case, you would be billed by the service dealer.

The warranties and guarantees we have just discussed apply to the purchase of new sets. There is also another type of guarantee which applies to ordinary repair work performed by the television service shop. Most replacement parts with the exception of picture tubes, are guaranteed 90 days. Many shops also guarantee the labor for 90 days. However, some shops may charge for labor to replace a guaranteed part. It should be understood that such guarantees apply only to the work performed by the service shop. For example, if your set is serviced and then a week or so later something else fails, you cannot expect the additional repair work to be covered by the first guarantee. If the set requires additional adjustments or the technician overlooked some-

thing, there may not be any additional charge. However, some shops do have a minimum charge for a callback. Due to the nature of electronic components, a part can fail spontaneously at any time. The technician can test tubes and make other checks to detect some potential failures, but most of the time there is no prior indication that a given part will fail. For this reason, service guarantees are limited to the actual work performed by the service dealer.

RESPONSIBILITIES OF THE SERVICEMAN AND THE SET OWNER

When you take your set to the service shop for repair, the shop owner assumes certain responsibilities. His primary responsibility, of course, is to perform the service needed in a professional manner. If you have requested an estimate, he should see to it that you are given an estimate before any repairs are made. In addition, the serviceman is responsible for any damage that may occur to the set while it is in his shop. Some shops waive responsibility for implosion of the picture tube due to accidental breakage. In this case, you may be asked to sign a picture tube release form. Although liability laws vary from state to state, a few service shops may even refuse to accept responsibility for losses due to fire or theft. However, most reliable shops carry adequate insurance and will usually accept full responsibility for sets left in their care. It is a standard policy of many shops to waive all responsibility if the set is not picked up within a reasonable time after the repairs are completed. This time is usually limited to 30 days unless some prior agreement has been made.

When the technician comes to your home for a service call, he must exercise reasonable care to see that your property is not damaged during the service operation. At the same time the set owner has certain obligations to the serviceman. He must provide sufficient room for the serviceman to work and see to it that the area is adequately lighted. It is extremely difficult for a technician to properly service a

television receiver in tight, cluttered surroundings. Also, you should not allow children or pets to annoy and pester the serviceman while he is working on your set. You may be charged for some wasted time. Finally, when the repair work is finished, the primary obligation of the set owner is to pay the bill. Most television service shops *do not* carry charge accounts. Most adhere to a strictly COD policy. If you are unable to pay for having your set serviced, let the serviceman know before he works on your set. Some service shops have arrangements with finance companies or accept charge cards.

Most people would like some idea of what a repair job is going to cost before they authorize the work. When you take your set to the shop for an estimate, in all probability you will be charged for the estimate if you decide not to have the set repaired. In many cases it is impossible for the technician to make a totally accurate estimate without extensive testing. In some cases, it is even necessary to make the actual repairs before an accurate estimate can be given. However, the technician can usually make a rough estimate for a moderate charge. Some states now have consumer laws that require that the customer be notified if repair costs will exceed the estimate. Such laws usually apply only when the customer specifically requests an estimate of the cost to make the necessary repairs. If the customer then decides not to go ahead with the repairs, he will be expected to pay for the labor performed and for any parts that are not recoverable. Also, when the technician has made a service call to your home and you decide not to have your set repaired, you will be expected to pay for the service call.

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